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PREDICTION OF TEACHER PERFORMANCE AND EMOTIONAL STABILITY--A PSYCHOPHYSIOLOGICAL PILOT STUDY OF FEMALE STUDENT TEACHERS.

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THE PLAN OF THE RESEARCH INVOLVED PHYSIOLOGICAL AND PSYCHOLOGICAL TESTING OF STUDENTS ENROLLED IN TEACHER EDUCATION, AND SUBSEQUENT EVALUATION BY TRAINED OBSERVERS OF THE TEACHING PERFORMANCE OF THE SUBJECTS. THE SAMPLE WAS LIMITED TO ELEMENTARY SCHOOL TEACHER CANDIDATES BECAUSE OF THE IMPORTANT ROLE THE ELEMENTARY TEACHER PLAYS IN THE MENTAL HEALTH OF THE CHILD. BECAUSE THE MAJORITY OF CANDIDATES WERE FEMALES, THE SAMPLE WAS CONFINED TO WOMEN SUBJECTS. THE SUBJECTS WERE UNIVERSITY WOMEN, MOSTLY JUNIORS, AND CANDIDATES FOR THE GENERAL ELEMENTARY TEACHING CREDENTIAL. THEY WERE DRAWN FROM THE UPPER DIVISION COURSE REQUIRED OF ALL PROSPECTIVE ELEMENTARY TEACHERS. PARTICIPATION IN THE PHYSIOLOGICAL TESTING WAS REQUIRED AS A PART OF THE TESTING PROGRAM FOR ALL SUCH TEACHER-CANDIDATES. FOR THESE 279 SUBJECTS, ADEQUATE PHYSIOLOGICAL DATA WERE OBTAINED FOR 247, AND ADEQUATE PSYCHOLOGICAL DATA AND EVALUATIONS OF STUDENT TEACHER PERFORMANCE WERE OBTAINED FOR SOMEWHAT SMALLER NUMBERS. ONLY AS STRESSES ACCUMULATE AND ATTRITION OCCURS WILL IT BE POSSIBLE TO TEST THE HYPOTHESES WHICH INDUCED THIS STUDY. ONLY LATER, THEN, CAN THE VALUE OF THIS STUDY FOR EDUCATION BE ASSESSED. (JL)

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PREDICTION OF TEACHER PERFORMANCE AND EMOTIONAL STABILITY:

A PSYCHOPHYSIOLOGICAL PILOT STUDY OF FEMALE STUDENT TEACHERS

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ABSTRACT

PREDICTION OF TEACHER PERFORMANCE AND EMOTIONAL STABILITY:
A PSYCHOPHYSIOLOGICAL PILOT STUDY OF FEMALE STUDENT TEACHERS

Statement of the Problem

This study constitutes the first extensive investigation in a young adult female population of functions innervated by the autonomic nervous system (ANS), and the first use of a psychophysiological test battery in research on teacher performance.

The investigation was based on the theses that: (1) measures of individual differences in ANS functions, be they inherited or acquired, afford a means of predicting those potential teachers who will be least likely to withstand the stresses involved in teaching; and (2) these measures used in conjunction with selected indices of personality and mental health and controlled observations of teaching performance will provide improved predictive indices of teacher performance. If stress-prone individuals can be detected in advance and directed toward occupations less stressful than daily classroom teaching, the effect should be salutary for their own mental health and that of school children saved from their ministrations.

Procedure

Prior to student teaching 279 female students enrolled in elementary teacher education were engaged in a required test program which involved a series of psychological tests and a series of physiological tests designed primarily to assay functioning of the autonomic

nervous system. Later, at the end of sixteen weeks of student teaching, assessments of classroom teaching performance for 217 subjects were obtained through the use of two instruments: (1) the Classroom Observation Record developed by Ryans (Characteristics of Teachers, 1960) and, (2) the University of California Rating Scale. University supervisors and outside observers trained in the use of the rating instruments conducted the observations of student teaching.

The first step in the analysis involved inspection of the distributions of the physiological data for nonnormality, and the application of appropriate transformations to reduce skewness and to effect homogeneity of variance. The data then were tested for possible effects of climatic variables, air contaminants ("smog"), and other uncontrolled factors, and corrected as necessary. The corrected data then were submitted to factorial analysis to test the thesis that an autonomic factor existed among young adult women comparable to that previously reported for children and young adult men. Equations were derived for estimating the factors obtained from the population and factor estimates were computed. The last step in the analysis was to correlate all physiological and psychological data with the various indices of student teacher performance.

Results and Conclusions

The contributions of the study may be summarized as follows:

1. A body of data which may be validated against in-service teaching performance by means of appropriate follow-up studies has been provided.

2. The study provided the first normative data concerning functioning of the autonomic nervous system in young adult females. The means and standard deviations constitute a body of data which can be employed by other researchers for comparative purposes in psychophysiological research.

3. The study provided the largest sample yet available for investigating the need for transformations and corrections of continuously recorded physiological data. Transformations were found necessary for several of the distributions, and it proved necessary to correct every physiological variable in terms of one or more uncontrolled factors. Most significant among the latter were: time of testing, room temperature, external temperature at time of testing, and lowest relative humidity and highest barometric pressure during the twenty-four hours prior to testing. The results illustrate the need for other investigators to consider these problems.

4. The study pioneered in the factorial investigation of physiological measurements in young adult females. A general factor of autonomic function was described and an equation presented for its estimation, thus providing a new research tool.

5. Three of the psychological and physiological variables proved to be significantly related to indices of student teaching performance. Although the latter are regarded as potential predictors of in-service teaching and not as appropriate validation criteria, the results suggest that these three variables at least will prove of value in the prediction of in-service teaching performance. These variables and the obtained relationships are: (a) scores on the

Guilford-Zimmerman Scale S were positively related to teaching performance, (b) characteristic level of muscular tension was negatively related to teaching performance, and (c) finger temperature was positively related to teaching performance.

The good student teacher can thus be characterized as relaxed, sociable, and possessing high finger temperature. In a follow-up study of the subjects during their in-service teaching now underway, it is hypothesized that this description of the good teacher will also obtain. However, it is also predicted that ability to withstand the daily and accumulative stress of in-service teaching will involve other variables that were investigated in this pilot study, in particular, estimates of the autonomic factor.

Summary Statement

The study, as originally proposed, provided for three years of physiological testing and three years of follow-up evaluation of in-service teaching of elementary teachers. The investigators complied with the suggestion that a pilot study be conducted, and the United States Office of Education contract, number 648 SAE 8311, was executed during the period 1 September 1959 to 31 March 1961 (extended to 30 September 1961).

Although this pilot study was limited in time, scope, and size of sample, contributions to basic science have been made and sufficient evidence has been obtained to warrant the application of the procedures to further educational and psychophysiological research.

Funds have been obtained by one of the investigators (WHL) for a one-year follow-up study on the subjects of the present investigation.

This study will be concerned with relating existing data (and subsidiary physiological data from a related study on similar subjects at UCLA) to various measures of in-service teaching performance, and physical and mental health.

W. H. Lucio, M. A. Wenger
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1. INTRODUCTION

The Problem

Adequate teacher selection is of crucial importance to the teaching profession. Responsibility for providing increased numbers of teachers capable of meeting the stresses of teaching and for improving the quality of persons entering the teaching profession has pointed up the need for more effective procedures of teacher selection.

Present methods for predicting teaching performance place emphasis upon intellectual abilities and achievement. Although the importance of motivation, desirable personality characteristics, and mental health have been recognized, little success has resulted from attempts to measure motivation, and there have been few well-designed predictive studies using personality and mental health indices. Moreover, except for some recognition that temperament plays a role in teacher performance, individual differences in physiological functions have been neglected.

This pilot research study has required the crossing of boundaries between psychophysiological and educational research. It constitutes the first extensive study of autonomic functions in a female population, and the first use of a psychophysiological test battery in research on teacher performance.

The study represents a systematic investigation of the relationships of physiological and personality variables to teacher performance and to the emotional stability of teachers, utilizing a sample of female elementary teacher candidates. The physiological aspect of the study is based on the thesis that measures of individual differences in the functioning of the autonomic nervous system (ANS), be they inherited or acquired, afford a means of predicting those potential teachers who will be least likely to withstand the stresses involved in teaching, and, used in conjunction with selected indices of personality and mental health, will lead to the development of improved predictive indices of teacher performance.).10^{6}

The justification for testing the value of ANS measures in teacher selection is derived from many sources. Briefly, the ANS is known to be involved in emotional behavior and emotional disorders. The work of Wenger and Ellington (1943), Wenger (1948, 1957), and that of other researchers (see Reviews by Darrow, 1943 and Kuntz, 1951) has shown that individual differences in ANS function are measurable and are related to aspects of behavior and personality. If stress-prone individuals can be detected in advance and directed toward occupations less stressful than daily classroom teaching, the effect should be salutary for their own mental health and that of the many school children saved from their ministrations.

Another aspect of the problem, that concerned with the selection of methods of teacher assessment, is reflected in Ryans' work in the development of instruments to measure teacher classroom-behavior (1960). The Classroom Observation Record (COR) developed by Ryans and the University of California Rating Scale (UR) were used in the assessment of teaching performance in this study.

In brief, measures of individual differences in the functioning of the autonomic nervous system (ANS) in conjunction with selected indices of personality and mental health were utilized. These measures were correlated in this pilot study against observed estimates of teacher performance. They will be validated against in-service teaching performance and information concerning emotional stability and physical health in a follow-up study.

Other Related Research

(A) Teacher Selection. The literature pertaining to investigations of the relationship between various hypothesized predictors and teaching effectiveness is extensive, but, unfortunately, consists of work which suffers from inadequate considerations of control and lack of replication. Many investigators have failed to specify the conditions of their studies sufficiently to enable comparison of their findings with those of other researchers. Consequently, in spite of the existence of a large number of studies purporting to determine concomitants of teacher competency, very little usable evidence is available to teacher education specialists or public school personnel officers. There is no question but that the worker in this area is confronted by numerous problems (Lucio, 1960; Ryans, 1960). Literature in the field has been scrutinized and annotated bibliographies and critical reviews are numerous. One of the more comprehensive reviews of investigations dealing with the identification and prediction of teaching effectiveness is that of Morsh and Wilder (1956). These writers have summarized the quantitative studies appearing between 1900 and 1952, have dissected them, have categorized the methodologies employed, have synthesized the findings, and have noted perplexing problems. Annotated bibliographies have been provided, also, by Domas and Tiedeman (1950), Castetter, Standlee, and Fattu (1954), and Waters (1954), among others. Ryans (1960), in a study sponsored by the American Council on Education, has contributed new knowledge on the kinds of personality traits which make one teacher more effective than another. His study is one of the first comprehensive investigations of teacher behavior presenting information on the traits of 6,000 teachers in 1,700 elementary and secondary schools. Ryans' findings have been described in detail (1960).

(B) ANS Measurement. In 1939 Wenger and his associates initiated work designed to measure individual differences in physiological functions which gave promise of being correlated with overt behavior. The work involved the measurement of a number of autonomically innervated functions in a population of children, the intercorrelation and factorial analysis of the data, and the estimation of the obtained autonomic factor for the individual children. Such factor estimates were called "Scores of Autonomic Balance." These studies with children (1943) and with adults (1948, 1957) led to conclusions which were summarized by Wenger, Engel, and Clemens (Appendix J). Particularly pertinent are the following conclusions:

1. Stable individual differences in autonomic functioning during controlled rest exist in both children and adults.

2. These differences are related to certain personality patterns and to certain diagnostic categories, such as anxiety

psychoneurosis, schizophrenia, battle fatigue, and asthma.

3. For greatest predictive value, measures of autonomic balance and patterns during rest should be supplemented by measures of reactions to a standard stimulus.

Wenger has continued to publish extensively in the field. His current work, in one laboratory, involves studies of psychosomatic patients; in another, male students have been used in a series of normative studies of ANS reactions to a wide variety of stimuli. The present study with females represents a cooperative effort to expand psychophysiological research to a new area of investigation.

Hypotheses

(A) Individual differences in autonomic response patterns furnish a basis for the prediction of those individuals who cannot well withstand the stress of teaching and those who may develop specific psychosomatic and other psychological disorders, and (B) such measures will improve the predictive value of psychological correlates of teacher performance.

2. SUBJECTS AND PROCEDURES

The over-all plan of the research involved physiological and psychological testing of students enrolled in teacher education, and subsequent evaluation by trained observers of the teaching performance of the subjects during student teaching. The sample was limited to elementary teacher candidates because of the important role the 106 elementary teacher plays in the mental health of the child. Because the majority of candidates were females, the sample was confined to women subjects.

Subjects

The subjects were 279 women, most juniors in the University, all candidates for the general elementary teaching credential. They were drawn from the upper division course required of all prospective elementary teachers; participation in the physiological testing was required as a part of the testing program for all such teacher-candidates. Their ages ranged from 20 to 42 with a mean age of 22.7; only ten were over 30 years of age.

Prior to the period of physiological testing all subjects had been routinely screened for entrance to the teacher education program by the Office of Student Services of the Department of Education. Screening measures included proficiency in communication skills, assessment of the quality of academic work, and health and personal fitness.

Of the total of 279 subjects, 240 were later enrolled in student teaching at which time observations and recordings were made of teaching performance. Although a larger number of subjects was available for testing, the final sample usable in any of the analyses was reduced for one or more of the following reasons: no potential subject who was pregnant, under continuing medication, or whose menstrual cycle was aperiodic was tested. Some potential subjects who broke their testing appointments or who were ill, or who had high sublingual temperatures were not available for re-scheduling and testing. Some subjects dropped from the teacher education program before or after they had received physiological testing; while others were tested but had not yet enrolled in student teaching at the termination of the research contract. The number of subjects thus varies in different portions of the analyses. All 279 subjects received physiological testing but adequate data were obtained for only 247. Of these, 217 received one or more evaluations of student teaching performance.

Psychological Testing

As a part of the group testing program for all teacher education candidates a number of psychological tests are regularly administered by the Office of Student Services. However, due to various administrative reasons beyond the control of the researchers, a number of subjects who participated in this study were not given the complete selection battery and hence scores from several of the tests were not available. These differences are accounted for in the analyses presented in the sections which follow. The scores from three of the tests administered by the Office of Student Services were available for use in this study. The tests included the Guilford-Zimmerman

Temperament Survey, the Cooperative English Test, and an Arithmetic Concepts Test (locally developed by the Office of Student Services).

The Guilford-Zimmerman Temperament Survey (G-Z) is described in detail in the Manual of Instructions for the test (published by Sheridan Supply Company, Beverly Hills, California). Briefly, the test is designed to sample ten traits with 30 items for each of the ten traits (see Appendix G). It is claimed that the G-Z Survey is a systematic, impersonal interview, which can be objectively scored. The items in the G-Z Survey are stated affirmatively rather than in quèstion form, using the second-person pronoun. The alternative responses to the 300 items in the G-Z Survey are: "Yes," "?", and "No." From the total "Yes" and "No" answers a total score was obtained for each of the ten separate traits. Total question marks were scored as a separate index.

An additional index was obtained by means of a Scale for Rating Characteristic Level of Muscular Tension. This instrument, developed by Wenger (1948, Appendix C), was employed after observing the subjects in teaching situations. The observers placed a check mark at an appropriate point on a vertical scale. No scoring formula was shown on the rating scale, but a nine point scale was later applied for scoring, ranging from a 0 for the lowest scale point ("so relaxed he looks and acts almost asleep") to a 9 for the top of the scale ("tense"). All observers were trained in the use of the Muscular Tension Scale with particular emphasis being given to rating observed overt muscular tension only, without regard to "emotional" behavior.

Physiological Testing.

As stated previously, nonvoluntary subjects were scheduled for physiological testing in a class in which all teacher-education candidates were required to enroll. An Instruction Sheet was used in arranging appointments for testing (Appendix H). The following instructions were given both verbally and in printed form to the subjects prior to testing:

1. Get an average satisfactory amount of sleep the night before the appointment.
2. Do not take any drugs (medications) or alcohol for a twenty-four hour period preceding the appointment.
3. Do not take food, coffee, tea, or coca-cola for at least two hours preceding the appointment.
4. Do not smoke or drink water for at least 1/2 hour preceding the appointment.

The laboratory was situated in the University Elementary School on the University of California campus. Within a large room, which contained the recording apparatus and work space, there was a semi-soundproof cubicle (10' x 8' x 8') which served as the subject room. The room contained only a cot, with foam-rubber mattress, and the detector units for the intended measurements. A two-way intercommunication system was provided, and the subject could be observed through a window. Room temperature could be controlled within limits (M= 25.0; σ= 1.8) but was determined for each testing session, and treated as an uncontrolled variable. Time of testing was confined to the morning and afternoon hours (8:30 a.m. to 4:30 p.m.), and also was analyzed as an uncontrolled variable.

The testing procedures have been used in many investigations of male subjects, and have been described in detail (Wenger, 1948; Wenger, Clemens and Engel, 1957 - see Appendix J). Briefly, they involve the collection of two classes of information - resting or pre-stimulus data, and reactions to placing the right foot in iced water, to the level of the internal malleolus, for one minute. Recovery data were obtained, but have not yet been analyzed.

The methods of obtaining and transcribing the data are briefly described in the following paragraphs.

A. Pre-stimulus Data - Initial Measures.

(1) Salivary output: The subject was seated on the cot and instructed to bring as much saliva as possible to the front of her mouth during a three-minute period. The output was drawn through a sanitary plastic ejector held just between her lips and into a calibrated centrifuge tube by means of the negative pressure produced by a filter pump attached to a water faucet. The output was determined by reading the volume at the bottom of the miniscus to the nearest tenth of a cubic centimeter, and the datum was transformed to square root of cubic centimeters output.

(2) Sublingual temperature: This measure was obtained with an ordinary clinical thermometer which the subject, while seated, held under her tongue for at least three minutes. The temperature was read in degrees Fahrenheit to the nearest tenth and transformed to the log of 102 F. minus the temperature.

(3) Standing Palmer conductance: The subject was instructed to

stand in a relaxed position, feet slightly apart, and arms at her side. The electrodes attached to both palms consisted of zinc plates 3 cm. in diameter, countersunk in plastic cups. Contact with the skin was made with an agar-1% zinc sulfate paste. The electrodes were connected to a Levine potentiometer. The voltage drop across the subject was recorded to the nearest tenth of a volt at the end of one and two minutes with a 40 microampere D.C. current. These values were converted to conductances and their mean was transformed to log micromhos conductance.

(4) Pupil diameter: Over her preferred eye the subject held a 5 x 8 inch black card on which pairs of pinpoint holes were drilled along converging lines so that the distances between pairs increased in half-millimeter steps from 2.5 to 8.0 mm. The other eye was covered by one hand. Through the holes she fixated an object 30 feet away, moving the card up and down until she found the pair of holes which provided tangent images. The images may appear as over-lapping, separated, or tangent depending on their relationship to the size of the pupil. When the center-to-center distance between the holes is equal to the diameter of the pupil the images appear tangent, and the experimenter can read the pupil diameter from the opposite side of the card. The process was repeated until two consistent readings were obtained, and the datum was their value in millimeters.

(5) First finger temperature: The first measure of finger temperature was obtained with a laboratory thermometer while the subject was seated. The subject held the bulb between the thumb and first two fingers of the nonpreferred hand for three minutes. The

temperature was read in degrees Centrigrade to the nearest tenth and transformed to the log of 40 C. minus finger temperature.

(6) Dermographia latency: After the subject had reclined on the cot, red dermographia was elicited by the application of the rounded point of a stimulator calibrated to deliver 200 gm. pressure. The pattern of an X was made over the left biceps muscle by two strokes, each approximately 3 inches long and requiring about one second. At the incidence of the first stroke the experimenter started a stopwatch, and the latency of the red X response was recorded to the nearest second. This datum was transformed to square root of seconds.

(7) Dermographia persistence: The disappearance of the red X produced by the dermographia stimulator was recorded in minutes to the nearest tenth, and the datum transformed to log minutes.

(8) Log palmar conductance change: This measure represented the greatest difference between palmar conductance during rest and during muscular strain. The measure during strain was obtained immediately after the standing measure previously described, using the same apparatus. The subject sat on a stool with arms outstretched and hands relaxed. She was instructed to raise her legs as high as possible and to "keep straining every muscle." The potentiometer was continuously adjusted so that a 40 microampere current flowed through the subject, and the lowest voltage drop during one minute of strain was recorded to the nearest tenth of a volt and converted to log micromhos conductance. While the subject later was reclining prior to cold pressor stimulation, palmar resistance was continuously recorded with the same electrodes, but by means of a Darrow-type bridge

with a range of 500,000 ohms. A constant current of 40 microamperes was impressed through the electrodes and the output was DC amplified. Calibration was determined by bridge regulation. The highest resistance during the first 12 minutes of recording was determined and transformed to log micromhos conductence. This measure was subtracted from the strain measure to obtain the datum for log conductance change.

B. Pre-stimulus Data - Continuous and Intermittent Measures.

The twelve variables, described in this section, were recorded continuously or intermittently while the subject reclined on the cot before, during and after cold pressor stimulation. Except in the case of blood pressure and stomach motility, samples were obtained: (a) in the last 30 seconds of each minute during 15 minutes of rest preceding stimulation; (b) for each 30 seconds during stimulation and during the first minute after stimulation; and (c) in the last 30 seconds of each minute during a 15 minute recovery period. The variables were:

(1) Palmar conductance: The recording technique for this variable was described in the preceeding section. Each sample consisted of the mean of the resistance levels measured to the nearest thousand ohms, at the midpoint and end of the thirty-second interval, and transformed to log micromhos conductance.

(2) Volar conductance: The apparatus and recording procedures were identical to those employed for palmar conductance. Electrodes were placed on the volar surfaces of the forearms, 8-10 cm below the elbows. Samples were obtained in the same manner as for palmar conductance. The pre-stimulus datum was the highest resistance level

during the first 12 minutes of rest. This measurement was transformed to log micromhos conductance.

(3) Systolic blood pressure: A standard Tycos pressure cuff was attached to the subject's upper right arm, and a small stethescope diaphragm was fastened over the brachial artery. Tygon tubing extended the system to the experimenter's room. The cuff was inflated once every three minutes before cold pressor stimulation, once during stimulation, and once every two minutes following stimulation. Systolic blood pressure was read in millimeters of mercury as the point of first appearance of heart sounds. The pre-stimulus datum was the mean of the two lowest readings.

(4) Diastolic blood pressure: The point of marked muffling of the heart sounds during gradual deflation of the cuff (4th blood pressure phase) was taken as the diastolic blood pressure reading. The pre-stimulus datum was the mean of the two readings accompanying those used for systolic pressure.

(5) Pulse pressure: The datum for this measure was the difference between the systolic and diastolic pressure data.

(6) Heart period: The EKG was obtained from continuous AC recording by Lead I with standard electrodes. Heart rate for each sample interval was measured by counting the number of R waves within the interval. For the pre-stimulus value, each sample was converted to mean period in milliminutes per 10 cycles, and the datum was the mean of 4 of the samples, taken at 3 minute intervals during the first 12 minutes of recording.

(7) Respiration period: A Baldwin SR-4 strain gauge was cemented to an aluminum plate attached to a strap which fastened around the subject's chest. The strain gauge functioned as one arm of a Wheatstone bridge, the output of which was DC amplified. Respiration rate was determined by counting the cycles within each sample interval to the nearest tenth cycle. For the pre-stimulus value, each sample was converted to mean period in seconds per cycle, and the datum was the mean of 4 of the samples, taken at 3 minute intervals during the first 12 minutes of recording, transformed to log seconds per cycle.

(8) Face temperature: Temperatures of the face, axilla, finger, and room temperature were recorded through a DC amplifier by means of Western Electric type 14B thermistors, each of which functioned as one arm of a Wheatstone bridge. All temperatures were recorded on one channel by means of a constant speed, motor-driven, selector switch which sampled face and axillary temperatures once and finger temperature twice every ten seconds. Room temperature was sampled approximately every three minutes. Calibration was accomplished by substituting known resistances for the thermistors, whose resistances at given temperatures had been predetermined. Face temperature was recorded from a thermistor attached with plastic tape to the center of the right cheek. The reading for each sample was the level in degrees Centigrade to the nearest tenth at the end of the sample interval. The level for the last sample prior to stimulation was taken as the pre-stimulus datum.

(9) Axillary temperature: A thermistor was mounted on a sponge

rubber pad and placed in the right axilla, where it was held in contact with the skin by the pressure of the subject's arm. The datum for this variable was obtained in the same manner as for face temperature.

(10) Finger temperature: A thermistor was attached to the palmar surface of the tip of the left index finger by plastic tape. The datum for this variable was obtained in the same manner as for face and axillary temperatures, and transformed to the log of 40C. minus the temperature. "Second Finger Temperature" was the last reading prior to stimulation.

(11) Finger pulse volume: A plastic cup was sealed over the left index finger so that 4 cc. were enclosed, and connected by Tygon tubing in a closed pressure system to a Statham P97 transducer used as a gauge transducer. Calibration was accomplished by switching a resistor in parallel with one arm of the transducer bridge to produce a pen displacement equal to that produced by a digital blood volume change of 5 microliters. Amplification was AC. Each sample consisted of the average amplitude in microliters to the nearest hundreth of the volume changes produced by the arterial pulse waves within the sample interval, as measured from the zero base of the AC channel. Each sample measure was transformed to the log of microliters X 100, and the pre-stimulus datum was the measure for the last sample prior to stimulation.

(12) Stomach period: The subject swallowed a 3/16" x 1/2" plastic coated Alnico No. 5 magnetic rod enclosed in a gelatin capsule. The movements of the magnet in the stomach were remotely detected and amplified by a magnetometer. The peak-to-peak distance between the first

and last Type I stomach contraction within each minute was measured to the nearest half second before, during, and after stimulation; and each measurement was converted to mean seconds per cycle of contraction. The last sample prior to stimulation was taken as the pre-stimulus datum.

C. Reactivity Data.

The reactivity datum for each of the continuously or intermittently recorded variables represented the difference between the level reached during or immediately after cold pressor stimulation and the level for the last sample prior to stimulation. For three variables the unit of measurement differed from that previously described. Heart and respiration rates were measured as cycles per minute, and finger temperature was measured in degrees Centigrade without a log transformation. The response levels from which the corresponding last pre-stimulus samples were subtracted were as follows:

(1) Systolic blood pressure: Highest pressure in millimeters of mercury recorded during the stimulus interval and the first subsequent minute.

(2) Diastolic blood pressure: Highest pressure in millimeters of mercury recorded during the stimulus interval and the first subsequent minute.

(3) Pulse pressure: Lowest pressure in millimeters of mercury recorded during the stimulus interval and the first subsequent minute.

(4) Heart rate: Maximum rate for any 15-second period within the stimulus interval, measured to the nearest half cycle and converted

to cycles per minute.

(5) Respiration rate: Maximum rate for any 15-second period within the stimulus interval, measured to the nearest tenth cycle and converted to cycles per minute.

(6) Palmar conductance: Lowest resistance within the stimulus interval, measured to the nearest thousand ohms and transformed to log micromhos conductance.

(7) Volar conductance: Lowest resistance within the stimulus interval, measured to the nearest thousand ohms and transformed to log micromhos conductance.

(8) Face temperature: Highest or lowest level in degrees Centigrade to the nearest tenth reached following stimulation as a result of an increase or decrease in level initiated within the stimulus period or the first subsequent minute.

(9) Axillary temperature: Highest or lowest level in degrees Centigrade to the nearest tenth reached following stimulation as a result of an increase or decrease in level initiated within the stimulus period or the first subsequent minute.

(10) Finger temperature: Lowest level in degrees Centigrade to the nearest tenth reached following stimulation as a result of a decrease in level initiated within the stimulus period or the first subsequent minute.

(11) Finger pulse volume: Lowest mean amplitude for any 15-second period within the stimulus interval, measured in microliters to the nearest hundredth and transformed to the log of microliters X 100.

(12) Stomach period: Shortest peak-to-peak distance between the first and last contractions of any one-minute period within the stimulus interval and the first subsequent minute, measured to the nearest half-second and converted to mean seconds per cycle of contraction.

Testing Procedure.

Approximately an hour and a half to two hours was required for the physiological measurements. Since the sex of the operator has been found to influence results obtained from female subjects, all operators for this study were females; and since phase of menstrual cycle also influences results, testing was confined insofar as possible to a seven-day period following cessation of menstruation.

On arrival at the laboratory the subject was seated and the experimenter explained the nature of the measurements and offered reassurance that the procedure would be painless. Data on age, weight, height, and smoking habits were obtained at this time. While sublingual temperature and first finger temperature were being measured, the skin conductance electrodes were applied. Next, pupil diameter, salivary output, and standing and strain palmar conductances were measured. The subject then ingested the magnet with a cup of water and reclined on the cot in the test cubicle. Dermographia was measured, and the various other electrodes and pick-up devices were explained and placed. The subject was told to lie as quietly as possible but not to fall asleep.

After continuous recording with the subject at rest for fifteen minutes, the operator instructed the subject, via the intercommunication system, to put her foot into the water and keep it there until the signal to remove it was given. A container placed to the right of the cot held iced water at a temperature of approximately 4 degrees Centigrade, which covered the foot to the level of the external malleolus. The stimulus interval was one minute. Following stimulation, recording continued throughout a fifteen minute recovery period to the termination of testing.

The Student Teaching Program

The student subjects in this study were enrolled in the regular sixteen-week student teaching program of the university in the semester following testing. There are two eight-week teaching assignments each at a different grade level. Students are assigned to a classroom in one of several cooperating schools, teaching under the direction of a resident classroom teacher. A University Supervisor of Elementary Student Teaching is assigned full time to each school and supervises a relatively small number of student teachers. These supervisors who are regular members of the University-Los Angeles City Schools staff served as supervisor observers throughout the study. The project director and one assistant served as outside observers.

The Evaluation of Student Teaching

In the initial planning of a long-term research concerning the prediction of teacher performance, the evaluation of student teaching was envisaged as only one of the indices to be employed in attempting to predict teaching performance and emotional stability. In this pilot study, however, it provides the major criterion variables against which tentative validations of the psychological and physiological data were accomplished. It should be emphasized that the authors do not regard these samples of student teacher performance as appropriate validation criteria. At best, they can afford no more than suggestions of the predictive value of the psychological and physiological data. In follow-up studies, which are planned, they will be employed as part of prediction information only.

Instruments Employed in Evaluation

Two instruments were used in the evaluation of student teacher performance:

(A) The University of California Rating Scale for Student Teaching (UR), (Appendix F), was filled out by the university supervisors at the end of sixteen weeks of teaching for each subject. This instrument contains two major rating categories, one on Personal Characteristics and one on Professional Competence. Each of these major categories contains a number of sub-items, all of which are rated by the assignment of a letter grade of A, B, C, D, or F, with A reflecting top performance and F the lowest performance. Numerical scores are assigned to each letter grade and the total score is obtained by summary of the individual letter numerical equivalents. In essence, the final total score reflects the academic grade a student receives in student teaching. The total over-all numerical score on the UR was used for correlational purposes in this study.

(B) The Classroom Observation Record (COR). This instrument and accompanying Glossary, developed by Ryans (1960, Appendix D and E), was used for all observations of classroom teaching and was considered the major measure of student teacher performance. The Classroom

Observation Record is a bi-polar scale based on the assumption that many personal-social traits of teachers may be assumed to constitute dimensions, the opposite extreme poles of which can be described operationally with considerable precision. The COR contains four Pupil Behavior and eighteen Teacher Behavior dimensions each of which is assessed on a seven point, or seven interval scale. A Glossary used with the COR describes the specific behaviors contributing to each of the bi-polar descriptions of teacher and pupil behavior.

Observer Training in the Use of the Classroom Observation Record

In preparing for classroom observations of student teachers particular attention was given to the training of the supervisor observers in the use of the COR. The supervisor observers were trained individually and in a group by the project director following Ryans' procedures (1960). The training procedure involved the following steps:

1. A review of the over-all design and purposes of the study and the use of the COR and Glossary. The problems involved in the observation and assessment of teaching were discussed in detail.
2. The observers studied the COR and Glossary and questions regarding interpretation and procedures were answered.
3. Practice observations and recordings of teaching performances were accomplished by the supervisor observers and project director.
4. Comparisons were made between the supervisors' ratings and the project director's ratings (outside observer), and the bases for assessments and the use of the Glossary clarified.
5. Supervisors and outside observers made observations of the

same student teachers, but at different times, and later discussed the assessments which had been made.

6. Regular observations of approximately thirty minutes each were then conducted at the end of each period of teaching, generally during the last week and a half of the eight-weeks and sixteen-weeks period.

The observations and ratings of the supervisors and outside observers were conducted independently. The outside observers had no prior knowledge of the teaching performance of any students observed. The use of the COR and Glossary were reviewed with the observers before and during rating periods. During regular visits of the project director to the various schools conferences were held with individual supervisors regarding rating procedures so that an almost continuous review of the assessment process was in operation.

The assessment procedure used in this study, therefore, involved five ratings of each student teacher, the observations being made at different times by the supervisor observers and the outside observers. The four independent ratings on the COR (and the one rating on the University of California Rating Scale) thus became the complete teaching performance record for each student teacher subject. Though ratings were made at eight-weeks and sixteen-weeks, only data on the final sixteen-week record were used, the earlier ratings being considered as practice ratings.

Statistical Analyses of the Data.

The major form of analysis involved correlation of the psychological and physiological data against the various indices of student teacher performance. A comparison of student teacher drop-outs with those who completed the program is planned. The psychological test data and the rating of teacher performance were employed without transformations. Many of the physiological data, however, required transformations to reduce skewness of the distributions, and many required correction for uncontrolled variables. These transformations and corrections are described in the following section.

After transformation and correction the physiological data were submitted to factorial analysis to test the thesis that an autonomic factor existed among young adult women comparable to that previously reported for children and young adult men. Equations were derived for estimating the obtained factors in the population studied; the factor estimates were computed and correlated with the criterion variables. These analyses were facilitated by the availability of an IBM 7090 Digital Computer and the Standards Western Automatic Computer (SWAC) on the campus of the University of California, Los Angeles.

3. TRANSFORMATIONS AND CORRECTIONS OF THE PHYSIOLOGICAL DATA FOR EFFECTS OF UNCONTROLLED VARIABLES

For psychological data it is usual to find normal distributions. For physiological data it is not unusual to find skewed or otherwise nonnormal distributions. An attempt was made to normalize, by appropriate transformations, all of the physiological variables whose distributions differed significantly from the normal. For the pre-stimulus data transformations were applied, as indicated by the units of measurement listed in Table G, to salivary output, sublingual temperature, palmar and volar conductance, palmar conductance change, respiration period, dermographia persistence, finger temperature, and finger pulse volume. The distributions of the transformed data for some variables (sublingual temperature, dermographia persistence and first finger temperature), and of the raw data for face and axillary temperature, still showed a degree of nonnormality significant at the .05 level of confidence; however, all except that of axillary temperature were symmetrical. The elimination of skewness was the most important consideration in these transformations, since violations of the assumption of normality tend to have little effect upon the results of parametric statistical tests unless the distributions involved are asymmetrical. The distributions of the pre-stimulus data therefore were regarded as satisfactory except that of axillary temperature, for which an appropriate normalizing transformation has not yet been found.

Measures of reaction to cold pressor stimulation involved the same transformations as the corresponding measures of pre-stimulus levels, with two exceptions: (a) reactions in heart and respiration were measured as rate instead of period, and were not transformed; and (b) finger temperature reactions were measured in degrees Centigrade, untransformed (see Table II). The distributions for systolic and diastolic blood pressure, face temperature, finger pulse volume and stomach period reactions were significantly non-normal but symmetrical. The distributions for palmar and volar conductance, and axillary temperature, however, were skewed in addition to being non-normal. The skewness of the distribution of volar conductance reactions was so extreme that this measure was not used in any data analyses. The skewness of the other variables was much less than that of volar conductance, but still sufficient to raise some questions as to the suitability of these measures for parametric statistical analysis. For the time being, these measures have been utilized in their present form, but further attempts are being made to find transformations which will make their distributions more symmetrical.

After these transformations the data were inspected for effects of uncontrolled variables. It was anticipated that some of the physiological data would have to be corrected for some uncontrolled environmental variables, and possibly for age and weight. Early work with children had demonstrated that seasonal climate in the mid-west of the United States was an important factor (Wenger, 1943). Later work with young adult males at Santa Ana, California (Wenger, 1948) found it necessary to correct only four physiological variables in terms of two uncontrolled variables: time of day, and room temperature. Current work in Los Angeles with young adult males, however, has found additional corrections necessary.

The subjects and circumstances of this study afforded the largest sample and most varied environmental conditions so far available for such an investigation. Measurements occurred between October 27, 1959, and August 17, 1960, on the University of California Campus in West Los Angeles. Although "smog" rarely causes distress in the area it is discernible at times. In this study, and in other contemporaneous work, its possible effects on the measures have been investigated. The data were made available by the Los Angeles Air Polution Control District (APCD). They included average and maximum daily concentrations of total oxidants, precursor oxidants, carbon monoxide, nitrogen dioxide, nitrogen monoxide, ozone, and sulphur dioxide; and average daily solar radiation, wind speed and inversion base height. In addition, the Department of Meteorology on the University of California campus furnished continuous measurements of air temperature, relative humidity, and barometric pressure.

The distributions of some of the atmospheric contaminant measures were positively skewed. Log transformations were applied to the measures of precursor oxidants, carbon monoxide, nitrogen dioxide, nitrogen monoxide, ozone and sulphur dioxide concentrations in order to normalize their distributions. None of the other uncontrolled variables was transformed.

Of these variables, and others obtained (room temperature and time of testing), partial correlations demonstrated that most could be excluded from further consideration, at least for our present purposes. Table A shows the correlation coefficients of the pre-stimulus physiological data against the uncontrolled variables that appear to be most important.** Table B shows comparable coefficients for reactions to cold pressor stimulation, and shows also the relationships to the pre-stimulus baselines.

The results clearly indicated that corrections were necessary. In particular, five uncontrolled variables - time of testing, initial room temperature, external temperature at the time of testing, and lowest relative humidity and highest barometric pressure in the 24 hours prior to testing - were prominent. It was decided to correct each physiological variable for all five of these uncontrolled variables if correction for any one of the five was indicated by correlation and inspection of trend. As a result of this decision all but one (dermographia latency) were corrected. In addition, some variables were corrected for age, weight, or oxidant concentration, as indicated by the analyses; and all physiological reactivity data were corrected for pre-stimulus baseline effects.

Table C shows the means and standard deviations of the uncontrolled variables that appear in Tables A and B; and presents also their coefficients of intercorrelation, as well as the arbitrary

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**For the physiological data of Tables A, B, C, F, G, and H, the maximum N was 247 and the minimum N (for stomach period reaction) was 68. Most variables involve N's of 200 - 245. The N's for evaluations of student teacher performance appear in Table O, page 48; those for Guilford-Zimmerman scores and muscle tension ratings appear in Table R, page 52.

Table A

CORRELATIONS OF PRE-STIMULUS PHYSIOLOGICAL MEASURES WITH UNCONTROLLED VARIABLES

	A	W	Ti	RT	T	H	P	Ox
Salivary output	-05	07	02	-04	-04	03	07	-08
Sublingual temperature	04	09	-22	21	-10	-30	29	-10
Palmar conductance	-12	-03	10	15	14	-21	13	-04
Volar conductance	12	07	03	12	-06	-13	18	02
Log conductance change	-06	17	-03	22	05	-21	15	07
Systolic blood pressure	02	15	-09	-11	08	09	-05	20
Diastolic blood pressure	18	16	-24	-10	06	-03	14	21
Pulse pressure	-13	03	09	-03	02	10	-14	00
Heart period	01	14	-16	-03	-02	03	-04	-02
Respiration period	04	09	-13	15	01	-09	15	01
Pupil diameter	-07	-02	-06	-11	-04	-02	-03	-10
Dermographia persistence	-19	-02	-09	02	-05	-19	13	-02
Dermographia latency	07	12	02	-05	10	-10	-01	-03
Face temperature	04	00	31	47	-12	-19	40	-11
Axillary temperature	07	-20	23	02	-01	03	00	-11
Finger temperature (1)	-06	-12	-23	-13	-37	-08	10	-25
Finger temperature (2)	-06	-06	-15	-36	-17	08	-12	-15
Finger pulse volume	-04	00	14	01	31	08	-15	20
Stomach period	-08	11	-12	04	-16	06	-01	05

A = age
W = weight
Ti= time of testing
RT= initial room temperature

T = external temperature at time of testing
H = lowest relative humidity in previous 24 hours
P = highest barometric pressure in previous 24 hours
Ox= maximum oxidant concentration on test day

Table B

CORRELATIONS OF PHYSIOLOGICAL REACTIONS TO COLD PRESSOR STIMULATION WITH UNCONTROLLED VARIABLES

	A	W	Ti	RT	T	H	P	Ox	Base
Systolic blood pressure	04	-04	12	-12	08	-05	-05	02	-16
Diastolic blood pressure	04	04	11	-00	13	01	05	08	-31
Pulse pressure	02	-03	-01	-06	-04	-08	-06	-04	-39
Heart rate	-08	05	01	-01	12	-16	09	09	-22
Respiration rate	-02	05	-11	05	-10	-08	10	01	-29
Palmar conductance	-13	-06	05	15	13	-25	15	-06	21
Finger temperature	12	03	-06	07	-02	-08	05	-08	-36
Face temperature	-01	03	04	-07	07	07	-06	06	-15
Axillary temperature	06	07	00	02	20	-11	03	13	-05
Finger pulse volume	-00	-08	-18	-14	-19	04	-06	-09	-58
Stomach period	-07	08	11	07	11	-06	-02	02	-38

A = age
W = weight
Ti= time of testing
Rt= initial room temperature

T = external temperature at time of testing
H = lowest relative humidity in previous 24 hours
P = highest barometric pressure in previous 24 hours
Ox= maximum oxidant concentration on test day
Base= pre-stimulus baseline

Table C

UNITS OF MEASUREMENT, MEANS AND STANDARD DEVIATIONS OF UNCONTROLLED VARIABLES, AND THEIR INTERCORRELATIONS

	Unit of measurement	Mean	S.D.	Correction Baseline*	Intercorrelations A	W	Ti	RT	T	H	P
Age	Years	22.7	3.9	22.0							
Weight	Pounds	122.4	15.2	120.0	13						
Time of testing	Hours	12.4	2.6	11.0	-14	-12					
Room temperature	C.	25.0	1.8	24.0	13	07	26				
External temperature	F.	63.9	7.2	65.0	10	06	15	07			
Lowest relative humidity previous 24 hours	Per cent	38.2	18.8	40.0	-04	-07	06	-37	-28		
Highest pressure previous 24 hours	Barometric inches	3009.4	10.2	3005.0	11	05	05	53	-05	-57	
Maximum oxidant concentration test day	Parts/100 million	10.9	6.8	5.0	15	12	-02	01	50	-05	-07

*The correction baseline is the arbitrary value used in place of the sample mean in the correction equations for the resting and reactivity physiological measures.

baseline values employed in the correction equations. The correction equations appear in Tables D and E, and Table F presents the uncorrected pre-stimulus means and standard deviations upon which the corrections of physiological reactions to cold pressor stimulation were based. It should be noted that, for purposes of convenience, arbitrary baseline values were employed instead of the sample means. These "correction baseline" values also appear in Tables F and C. The means and standard deviations of the corrected data are presented in Tables G and H.

Table D

EQUATIONS FOR CORRECTION OF PRE-STIMULUS PHYSIOLOGICAL MEASURES

Salivary output	$z_c = z_x - .04z_3 + .11z_4 - .09z_6 - .18z_7$
Sublingual temperature	$z_c = z_x - .04z_2 + .22z_3 - .15z_4 + .13z_5 + .21z_6 - .09z_7$
Palmar conductance	$z_c = z_x + .14z_1 - .05z_3 - .10z_4 - .09z_5 + .17z_6 + .022_7$
Volar conductance	$z_c = z_x - .12z_1 - .06z_3 - .01z_4 + .11z_5 + .10z_6 - .10z_7$
Log conductance change	$z_c = z_x + .12z_1 - .15z_2 + .07z_3 - .21z_4 - .01z_5 + .14z_6 + .03z_7$
Systolic blood pressure	$z_c = z_x - .13z_2 + .06z_3 + .11z_4 - .05z_5 - .14z_6 - .10z_7 - .18z_8$
Diastolic blood pressure	$z_c = z_x - .10z_1 - .11z_2 + .19z_3 + .20z_4 - .04z_5 - .13z_6 - .33z_7 - .19z_8$
Pulse pressure	$z_c = z_x + .11z_1 - .06z_3 - .05z_4 - .02z_5 - .04z_6 + .13z_7$
Heart period	$z_c = z_x - .12z_2 + .16z_3 - .03z_4 - .04z_6 + .03z_7$
Respiration period	$z_c = z_x + .19z_3 - .10z_4 - .05z_5 - .06z_6 - .11z_7$
Pupil diameter	$z_c = z_x + .05z_1 + .01z_3 + .12z_4 + .10z_5 + .11z_6 + .03z_7$
Dermographia persistence	$z_c = z_x + .21z_1 + .10z_3 + .03z_4 + .04z_5 + .17z_6 - .07z_7$
Face temperature	$z_c = z_x - .25z_3 - .30z_4 + .18z_5 + .02z_6 - .21z_7$
Axillary temperature	$z_c = z_x + .17z_2 - .22z_3 + .03z_4 + .04z_5 + .01z_6$
Finger temperature (1)	$z_c = z_x + .11z_2 + .14z_3 + .17z_4 + .32z_5 + .20z_6 - .06z_7 + .12z_8$
Finger temperature (2)	$z_c = z_x + .02z_3 + .39z_4 + .17z_5 - .10z_6 - .03z_7$
Finger pulse volume	$z_c = z_x - .07z_3 - .07z_4 - .33z_5 - .14z_6 + .09z_7$
Stomach period	$z_c = z_x + .14z_1 - .10z_2 + .19z_3 - .14z_4 - .07z_5 - .16z_6 - .03z_7$

z_c= corrected standard score
z_x= uncorrected standard score
1= age
2= weight
3= time of testing
4= initial room temperature
5= external temperature at time of testing
6= lowest relative humidity in previous 24 hours
7= highest barometric pressure in previous 24 hours
8= maximum oxidant concentration on test day

$z = (X_1 - B_1)/\sigma_1$ where the values of B_1 are the correction baseline values shown in Table C and X_1 is the raw score

Table E

EQUATIONS FOR CORRECTION OF PHYSIOLOGICAL REACTIONS TO COLD PRESSOR STIMULATION

Systolic blood pressure	$z_c = z_x - .17z_3 + .22z_4 - .04z_5 - .13z_6 = .02z_7 + .15z_p$
Diastolic blood pressure	$z_c = z_x - .03z_3 + .13z_4 - .20z_5 - .14z_6 - .24z_7 + .34z_p$
Pulse pressure	$z_c = z_x - .07z_3 + .04z_4 + .11z_5 + .21z_6 + .21z_7 + .40z_p$
Heart rate	$z_c = z_x - .07z_3 + .12z_4 - .08z_5 + .15z_6 - .07z_7 + .23z_p$
Respiration rate	$z_c = z_x + .05z_3 + .12z_5 = .09z_6 - .01z_7 + .28z_p$
Palmar conductance	$z_c = z_x + .14z_1 + .01z_3 - .09z_4 - .07z_5 + .22z_6 + .02z_7 - .20z_p$
Finger temperature	$z_c = z_x - .12z_1 + .03z_3 - .22z_4 + .02z_5 + .05z_6 + .05z_7 + .44z_p$
Face temperature	$z_c = z_x - .08z_3 + .02z_4 - .06z_5 - .08z_6 - .06z_7 + .17z_p$
Axillary temperature	$z_c = z_x + .01z_3 + .02z_4 - .19z_5 + .05z_6 - .02z_7 + .04z_p$
Finger pulse volume	$z_c = z_x + .08z_2 + .09z_3 + .04z_4 - .01z_5 - 01z_6 + .11z_7 + .59z_p$
Stomach period	$z_c = z_x + .12z_1 - .14z_2 - .03z_3 - .12z_4 - .02z_5 + .04z_6 + .11z_7 + .40z_p$

z_c= corrected standard score
z_x= uncorrected standard score
1= age
2= weight
3= time of testing

4= initial room temperature
5= external temperature at time of testing
6= lowest relative humidity in previous 24 hours
7= highest barometric pressure in previous 24 hours
p= pre-stimulus level

$z_i = (X_i - B_i)/\sigma_i$ where the values of B_i are the correction baseline values shown in Table C, and the values of B_p are the baseline values shown in Table E

Table F

UNCORRECTED PRE-STIMULUS MEANS, STANDARD DEVIATIONS, AND ARBITRARY BASELINES UPON WHICH CORRECTIONS OF PHYSIOLOGICAL REACTIONS WERE BASED

Variable	Unit of Measurement	Mean	S.D.	Correction Baseline
Systolic blood pressure	mm. Hg.	104.3	9.1	105.0
Diastolic blood pressure	mm. Hg.	66.6	7.9	65.0
Pulse pressure	mm. Hg.	37.8	10.3	40.0
Heart rate	cycles per minute	69.4	9.4	70.0
Respiration rate	cycles per minute	16.4	3.1	17.0
Palmar conductance	log micromhos	.735	.220	.700
Finger temperature	C.	30.93	3.84	32.00
Face temperature	C.	34.32	1.35	35.00
Axillary temperature	C.	35.88	.82	36.00
Finger pulse volume	log (microliters x100)	2.060	.240	2.000
Stomach period	seconds per cycle	20.94	2.09	20.00

Table 6

UNITS OF MEASUREMENT, MEANS AND STANDARD DEVIATIONS OF CORRECTED PRE-STIMULUS PHYSIOLOGICAL MEASURES

	Unit of measurement	Mean	S.D.
Salivary output	sq. root cc.	1.60	.48
Sublingual temperature	log (102.0 - F.)	1.555	.060
Palmar conductance	log micromhos	.978	.254
Volar conductance	log micromhos	.848	.104
Log conductance change	log micromhos	.420	.238
Systolic blood pressure	mm. Hg.	100.7	8.2
Diastolic blood pressure	mm. Hg.	65.0	6.8
Pulse pressure	mm. Hg.	35.8	9.0
Heart period	milliminutes per 10 cycles	147.4	18.9
Respiration period	log seconds per cycle	.576	.079
Pupil diameter	millimeters	4.61	1.14
Dermographia persistence	log minutes	.475	.302
Dermographia latency	seconds	15.6	4.9
Face temperature	C.	33.67	1.13
Axillary temperature	C.	35.76	.77
Finger temperature (1)	log (40.0 - C.)	.989	.190
Finger temperature (2)	log (40.0 - C.)	.952	.184
Finger pulse volume	log (microliters x 100)	2.062	.223
Stomach period	seconds per cycle	21.18	2.19

Table H

UNITS OF MEASUREMENT, MEANS AND STANDARD DEVIATIONS OF CORRECTED PHYSIOLOGICAL REACTIONS TO COLD PRESSOR STIMULATION

	Unit of measurement	Mean	S.D.
Systolic blood pressure	mm. Hg.	6.3	6.3
Diastolic blood pressure	mm. Hg.	6.1	7.3
Pulse pressure	mm. Hg.	-1.9	6.8
Heart rate	cycles per minute	14.6	8.5
Respiration rate	cycles per minute	3.8	3.2
Palmar conductance	log micromhos	.193	.178
Finger temperature	C.	-.05	.44
Face temperature	C.	-.004	.214
Axillary temperature	C.	.004	.103
Finger pulse volume	log (microliters x 100)	-.204	.109
Stomach period	seconds per cycle	-1.22	1.38

4. FACTORIAL ANALYSES OF THE CORRECTED PHYSIOLOGICAL DATA

After correcting the physiological data, as described in the preceding section, the next step in the analysis of the results was to test the hypothesis that an autonomic factor exists for young adult female subjects. Earlier work had demonstrated such a factor under resting and other controlled conditions for children (Wenger and Ellington, 1943), and for young adult males and selected male patients, (Wenger, 1948). A current study describes a similar factor for male college students and custodians (Wenger and Cullen, 1961). In that study, and in the present one, reactions to cold pressor stimulation also were analyzed to determine whether or not separate factors exist for autonomic reactivity.

The intercorrelations among the corrected pre-stimulus data for 245 female subjects are presented in Table I. The coefficients are perhaps the lowest yet reported for such data, but low coefficients do not preclude the existence of factors. They do indicate a higher degree of unique variance among these variables for these subjects than has been found in previous studies. Only further work can determine whether such results are attributable to females in general, to this particular sample, or to transformations and corrections of the data.

That common factor variance does exist among these data may be seen in Table J which shows the centroid solutions and the visually rotated solutions. As in previous work in this area, no attempt has been made to achieve simple structure, or positive manifold. Instead,

Table I

INTERCORRELATIONS AMONG PRE-STIMULUS

PHYSIOLOGICAL MEASURES

Variables		1	2	3	4	5	6	7	8	9	10
Salivary Output	1										
Sublingual Temperature*	2	06									
Palmar Conductance*	3	02	09								
Volar Conductance*	4	10	07	19							
Log Conductance Change	5	00	-01	-26	01						
Heart Period	6	-08	22	18	08	-03					
Finger Temperature	7	01	-02	-01	07	-04	11				
Respiration Period	8	05	04	00	-02	03	00	00			
Pupillary Diameter*	9	08	00	07	02	06	08	-09	-11		
Dermographia Persistence	10	09	-01	08	04	00	-09	-05	-03	03	
Systolic Blood Pressure*	11	03	06	16	00	-05	23	01	03	-04	01

* Indicates reflection of variable
Max. N= 245 females

Table J

THE FACTOR SOLUTIONS OF PRE-STIMULUS PHYSIOLOGICAL MEASURES

Variables		Centroid Solution I	II	III	IV	h^2	Rotated Solution I	II	III	IV	III'
Salivary Output	1	14	-15	27	13	13	-02	13	32	08	34
Sublingual Temperature*	2	26	19	10	12	13	-06	36	00	-01	20
Palmar Conductance*	3	52	-17	-21	-20	39	56	28	-04	01	12
Volar Conductance*	4	31	-08	23	-10	16	18	25	25	-08	35
Log Conductance Change	5	-24	08	17	29	18	-40	-05	07	13	03
Heart Period	6	40	42	-19	10	37	00	50	-35	-06	-02
Finger Temperature	7	-07	-13	-08	17	06	-02	-08	-01	23	-05
Respiration Period	8	-07	14	14	-08	05	-13	00	04	-19	03
Pupillary Diameter*	9	12	-18	-13	32	16	-03	08	-02	39	03
Dermographia Persistence	10	09	-25	08	11	09	10	02	20	20	18
Systolic Blood Pressure*	11	28	22	-11	06	15	04	33	-19	-01	02

* Indicates reflection of variable

Max. N= 245 females

following a suggestion made by Thurstone to one of us (Wenger), rotations have sought to maximize the predicted autonomic factor.

The present results are less definitive than in previous analyses of young adult males (Wenger, 1948). Although Factor II corresponds fairly well to previously described general autonomic factors, Factors III and IV are not interpretable, and Factor I appears to be a separate skin conductance factor. Graphic plots of the rotated solution suggested that Factor III might be more clearly defined if it were rotated obliquely toward Factor II. Factor III', which was the result of a 34° rotation, provided no better basis for interpretation than did the orthogonal Factor III.

Additional analyses of these data are being conducted. As previously stated, this is the first such study of physiological data in adult female subjects. Phase of menstrual cycle is known to be important in such measurements. Although attempts were made to control for this influence, they were not uniformly successful. Only further work can determine the reliability and validity of the obtained factors. For our present purposes, however, regression equations have been derived for estimating all five factors. The equations are shown in Table K. The estimates for all factors are utilized in the next section.

One comment should be added. We believe that Factor II represents a general factor of ANS function. As evidence for this belief we call attention not only to the constellation of rotated Factor II but to the following fact. The regression equation for estimating the autonomic factor for young male adults (Wenger, 1948) was applied to the

Table K

EQUATIONS FOR ESTIMATION OF FACTORS FROM PRE-STIMULUS PHYSIOLOGICAL DATA

Factor I $= -.47z_3 - .09z_4 - .27z_5 - .12z_8$

Factor II $= .12z_1 + .24z_2 - .12z_3 - .17z_4 + .37z_6 - .20z_{11}$

Factor III $= .20z_1 - .24z_4 - .30z_6 + .44z_{10} + .13z_{11}$

Factor IV $= .12z_4 + .20z_7 - .44z_8 - .39z_9 + .20z_{10}$

Factor III' $= .29z_1 + .10z_2 - .30z_4 + .44z_{10}$

1 = Salivary output

2 = Sublingual temperature

3 = Palmar conductance

4 = Volar conductance

5 = Log conductance change

6 = Heart period

7 = Finger temperature (2)

8 = Respiration period

9 = Pupil diameter

10 = Dermagraphia persistence

11 = Systolic blood pressure

$z_i = (X_i - \bar{X}_i)/\sigma_i$

data of the present study. The correlation between these estimates, and the estimates of Factor II of the present study, was .75. Such a result is hardly a chance statistic.

A factor analysis of reactivity to cold pressor stimulation also was conducted. The intercorrelations among the variables appear in Table L, which includes the major uncontrolled variables against which corrections were made. The latter were included for two purposes: to test the correction equations, and to define one or more hypothetical orthogonal factors. The centroid solution and a rotated solution obtained by Kaiser's Varimax method (1959) appear in Table M.

Wenger and Cullen (1961) have recently conducted another factor analysis for similar reactivity data from a male sample. That, and the present analysis, constitute the first extensive factorial investigations of physiological reactivity to any stimulus. For resting (prestimulus) data there exists a theoretical framework from which to predict a general factor of autonomic function (Wenger, 1948). No comparable theoretical basis exists for predicting a factor or factors for cold pressor reactivity data. For this reason we have deferred study of the reactivity factors. The basic data are presented here as a matter of record. They will be analyzed further.

Table L

INTERCORRELATIONS AMONG PHYSIOLOGICAL REACTIONS TO COLD PRESSOR STIMULATION AND SELECTED UNCONTROLLED VARIABLES

		1	2	3	4	5	6	7	8	9	10	11	12	13
Systolic blood pressure	1													
Heart rate	2	37												
Respiration rate	3	08	35											
Palmar conductance	4	05	-03	-12										
Face temperature	5	11	22	02	09									
Axillary temperature	6	-09	-13	-08	-05	00								
Finger pulse volume*	7	07	03	-05	06	00	11							
Stomach period	8	03	-06	-03	01	07	-06	-09						
Finger temperature*	9	04	00	-02	-05	06	-03	05	03					
Time of day	10	00	00	00	01	00	00	01	-01	-02				
Room temperature	11	00	00	00	01	00	01	-02	06	-01	26			
External temperature	12	00	-01	00	00	00	00	-01	02	-01	15	07		
Relative humidity	13	00	00	00	00	00	00	01	00	00	06	-37	-28	
Barometric pressure	14	00	00	00	00	00	00	-01	02	-01	05	53	-05	-57

* Indicates reflection of variable
Maximum N = 245 females

Table M

THE FACTOR SOLUTIONS OF PHYSIOLOGICAL REACTIONS TO COLD PRESSOR STIMULATION

		Centroid Solution							Varimax Rotated Solution					
		I	II	III	IV	V	VI	h^2	I	II	III	IV	V	VI
Systolic blood pressure	1	26	38	22	09	-11	14	30	00	55	00	02	-01	-02
Heart rate	2	40	57	16	-10	06	15	55	-01	67	06	-30	-01	-02
Respiration rate	3	29	34	-13	-25	26	-04	35	00	23	00	-54	02	00
Palmar conductance	4	-05	-04	19	18	-18	11	12	00	11	02	32	00	00
Face temperature	5	17	17	13	16	-11	08	12	01	32	-08	10	02	03
Axillary temperature	6	-16	-11	12	-14	05	11	09	01	-11	26	05	00	-03
Finger pulse volume*	7	-09	03	22	-05	-03	17	09	00	10	24	13	-02	-04
Stomach period	8	09	-06	-10	19	-09	-16	09	02	-03	-29	07	03	01
Finger temperature*	9	04	09	-04	05	-15	-10	05	00	08	-16	02	-09	-07
Time of day	10	18	-14	19	22	38	-07	29	02	02	-01	-01	53	06
Room temperature	11	52	-45	29	-07	11	-17	60	63	00	-05	00	45	01
External temperature	12	21	-17	-23	19	12	36	31	02	01	-03	00	09	54
Relative humidity	13	-50	42	11	25	26	-31	66	-07	-02	-03	00	16	-43
Barometric pressure	14	49	-40	20	-37	-28	-17	68	82	00	-03	00	00	-11

* Indicates reflection of variable
Maximum N = 245 females

5. RELATIONSHIPS AMONG RATINGS OF STUDENT TEACHER PERFORMANCE AND THE PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES

The next step in the analysis of results was to correlate the physiological and psychological data against the criterion variables - the Classroom Observation Record (COR) and the University of California Rating Scale for Student Teaching (UR). The COR indices (described in Section 2 and Appendix D) provide four discrete scores. These scores involve: independent ratings by the supervisors (Sup.) and by the outside observers (Obs.) of teacher behavior (TB), and pupil behavior (PB). The combinations of TB and PB provide the total rating (TR); and the means of the Sup. and Obs. ratings provide a mean score (M) for each rating category. Thus a total of nine scores were obtained from the COR. The means and standard deviations for all criterion variables and comparable data for the psychological measures appear in Table N. It will be noted that data for the Cooperative English Test and the Arithmetic Concepts Test are not shown. Correlations were obtained for these two tests against all criterion variables, but were not used in further analyses of the data, since all coefficients were below .10.

The intercorrelations for the nine COR scores, and for the University Rating (UR) are presented in Table O. It should be noted that the N varies for different categories in this and subsequent tables. The maximum N available (217) is for the ratings of the supervisors. The mean total rating (TR_m) also involved 217 subjects

Table N

MEANS AND STANDARD DEVIATIONS OF CRITERION VARIABLES AND PSYCHOLOGICAL MEASURES

	Mean	S.D.
Teacher behavior (Sup.)	5.4	1.12
Teacher behavior (Obs.)	5.0	.87
Teacher behavior (M)	5.2	.86
Pupil behavior (Sup.)	5.2	1.28
Pupil behavior	4.9	.98
Pupil behavior (M)	5.0	1.05
Total rating (Sup.)	5.3	1.09
Total rating (Obs.)	5.0	.86
Total rating (M)	5.1	.92
University rating	4.2	.58
Muscle tension	4.8	1.92
Muscle tension (Obs.)	4.9	1.51
Muscle tension (M)	4.9	1.42
G.-Z. scale G	17.7	5.4
G.-Z. scale R	19.3	4.2
G.-Z. scale A	17.7	5.2
G.-Z. scale S	23.8	4.2
G.-Z. scale E	22.1	4.2
G.-Z. scale O	21.6	4.2
G.-Z. scale F	20.6	4.7
G.-Z. scale T	18.8	4.7
G.-Z. scale P	22.8	4.6
G.-Z. scale M	13.1	4.1
G.-Z. question marks	17.1	20.1

Table O

INTERCORRELATIONS AMONG CRITERION VARIABLES*

COR	TB_s	TB_o	TB_m	PB_s	PB_o	PB_m	TR_s	TR_o	TR_m
Teacher behavior (Sup.)									
Teacher behavior (Obs.)	40								
Teacher behavior (M)	90	81							
Pupil behavior (Sup.)	71	32	67						
Pupil behavior (Obs.)	35	81	67	38					
Pupil behavior (M)	68	66	78	90	80				
Total rating (Sup.)	99	41	90	81	38	76			
Total rating (Obs.)	40	99	80	35	88	72	41		
Total rating (M)	88	81	99	74	73	86	90	82	
University Rating (UR)	71	35	63	65	35	60	73	36	65

---

* In this and in tables P and Q the maximum N's are 169 for UR, 187 for Obs., and 217 for Sup. and M.

but, since the outside observers obtained ratings for only 187 of these subjects, the data for 30 subjects represent not true means but Sup. ratings alone. Inspection of the data in the table will demonstrate that although the ratings by the Sup. and Obs. did not correlate highly for any of the three categories, the mean score for each category showed such high relationships to both supervisor and outside observer that the use of their separate contributions alone should contribute little. Moreover, since the total mean rating correlated .99 and .86 respectively with the means for sub-categories TB and PB, it seemed obvious that among the nine COR scales it (TR_m), should receive greatest consideration. The last row of the table, however, indicates that the University Rating (UR) should receive separate consideration. The highest correlation it shows with any of the COR indices is .73, and it relates only .65 to TR_m.

In spite of the foregoing indications it was decided to compute correlations for the physiological and psychological measures against all of the criterion variables. Such a procedure furnished a check for the assumptions previously stated. The correlation coefficients appear in Tables P, Q, and R.

In Table P which concerns the pre-stimulus physiological measures and the factor estimates, 18 significant relationships appear. It is of interest that the greatest number of significant coefficients occurred in columns TB_o, PB_o, and TR_o. This finding caused us to question the earlier decision to give greatest weight to criterion variables TR_m and UR, and led to a separate consideration of criterion TR_o, which correlated .99 and .88 with TB_o and PB_o respectively.

Table P

CORRELATIONS OF CRITERION VARIABLES WITH PRE-STIMULUS PHYSIOLOGICAL MEASURES AND FACTOR ESTIMATES

	TB_s	TB_o	TB_m	PB_s	PB_o	PB_m	TR_s	TR_o	TR_m	UR
Salivary output	-10	-14	-12	-06	-12	-11	-09	-13	-12	-04
Sublingual temperature	00	01	04	-06	-06	-03	-01	00	03	-13
Palmar conductance	-05	04	-03	04	10	06	-04	05	-01	05
Volar conductance	-02	02	-02	05	10	08	-01	03	-01	-02
Log conductance change	-08	07	-02	-03	06	01	-07	07	-01	-04
Systolic blood pressure	08	01	06	00	02	01	07	01	05	00
Diastolic blood pressure	06	-03	02	06	05	07	07	-01	04	05
Pulse pressure	03	02	04	-04	-02	-04	01	01	02	-03
Heart period	-04	-02	-05	-04	-07	-06	-04	-03	-06	06
Respiration period	02	-14	-05	00	-14	-06	02	-15*	-05	06
Pupil diameter	-01	-15*	-08	-02	-09	-07	-02	-14	-09	05
Dermographia persistence	-10	01	-05	-07	-05	-06	-10	00	-04	-14
Dermographia latency	08	-02	05	10	06	09	09	00	06	-03
Face temperature	-02	00	-04	-01	02	-03	-03	00	-05	-03
Axillary temperature	-10	-17*	-17*	-05	-14	-12	-11	-17*	-18*	-03
Finger temperature (1)	-02	-14	-07	-04	-20*	-12	-02	-15*	-09	-11
Finger temperature (2)	-12	-17*	-18*	-13	-19*	-19*	-13	-17*	-19*	-10
Finger pulse volume	03	07	07	05	04	04	04	06	06	09
Stomach period	18*	02	08	05	09	03	16*	03	07	05
Factor I	07	-03	05	-03	-09	-05	06	-05	02	-02
Factor II	-05	-04	-05	-08	-13	-10	-05	-06	-06	-03
Factor III	-03	-05	-01	-04	-07	-06	-03	-05	-02	-08
Factor IV	-11	09	-03	-08	02	-04	-10	08	-03	-14
Factor III'	-08	-09	-07	-11	-17*	-15*	-08	-11	-08	-09

*Significant at .05 level or beyond

TABLE Q

CORRELATIONS OF CRITERION VARIABLES WITH PHYSIOLOGICAL REACTIONS TO COLD PRESSOR STIMULATION

	TB_s	TB_o	TB_m	PB_s	PB_o	PB_m	TR_s	TR_o	TR_m	UR
Systolic blood pressure	-06	-03	-05	-09	-06	-09	-08	-03	-06	-15*
Diastolic blood pressure	00	00	01	-04	06	-01	00	01	01	-05
Pulse pressure	-03	05	-01	-01	-04	-03	-04	04	-02	-08
Heart rate	-07	-09	-06	-04	-03	-03	-07	-07	-05	-18*
Respiration rate	-10	-08	-11	-15*	-11	-16*	-12	-08	-13	-18*
Palmar conductance	05	01	05	08	04	10	06	01	06	-05
Face temperature	-02	11	06	-03	06	03	-01	10	06	03
Axillary temperature	13	06	12	09	-02	09	13	04	12	15
Finger temperature	15*	08	14*	10	01	09	15*	07	14*	03
Finger pulse volume	-03	00	00	-02	00	00	-03	00	-01	-08
Stomach period	11	-04	09	-04	-19	-11	08	-07	06	-02

* Significant at .05 level or beyond

Table R

CORRELATIONS OF CRITERION VARIABLES WITH GUILFORD-ZIMMERMAN SCORES AND MUSCLE TENSION RATINGS*

	TB_s	TB_o	TB_m	PB_s	PB_o	PB_m	TR_s	TR_o	TR_m	UR
G.-Z. scale G	06	00	08	11	02	12	08	00	09	08
G.-Z. scale R	10	13	10	03	17*	07	09	14	09	03
G.-Z. scale A	05	11	10	13	03	12	07	11	10	12
G.-Z. scale S	27*	14	26*	27*	11	25*	29*	15*	27*	33*
G.-Z. scale E	-01	05	-01	04	06	03	-00	06	-00	01
G.-Z. scale O	15*	05	10	19*	01	12	16*	05	11	15
G.-Z. scale F	04	00	00	01	-03	-03	04	-01	-01	-07
G.-Z. scale T	02	-04	-00	-05	00	-05	01	-03	-01	-13
G.-Z. scale P	10	08	06	02	-03	-01	09	07	05	00
G.-Z. scale M	-02	13	00	07	11	06	00	13	02	01
G.-Z. question marks	01	-02	-04	01	-09	-07	02	-09	-05	00
Muscle tension (Sup.)	-10	00	-09	-18*	-01	-13	-13	00	-10	-16
Muscle tension (Obs.)	-15*	-30*	-23*	-13	-30*	-23*	-15*	-31*	-25*	-11
Muscle tension (M)	-26*	-19*	-28*	-27*	-23*	-28*	-28*	-20*	-30*	-27*

* Significant at .05 level or beyond

Maximum N for G-Z scales = 201
Maximum N for muscle tension (Sup.) and (M) = 136
Maximum N for muscle tension (Obs.) = 193

In Table Q there also are few significant correlations, and no criterion except UR shows more than one. Only increases in respiration rate and decreases in finger temperature yielded three or more significant relationships with the criterion variables.

Table R shows more significant coefficients. Considering first the scores from the G-Z Survey, there are two significant relationships with each Sup. rating (TB_s, PB_s, and TR_s) but only two G-Z scales were involved - scales S and O. Only scale S (Sociability) shows general relationship to the ten criterion variables, and eight of the coefficients, including those for the two composites (TR_m and UR), attained statistical significance.

The outside observers contributed the major proportion of the significant relationships obtaining between ratings of muscle tension (MT) and the criterion variables. Although this raises the question of halo effect, the consistent significant relationships found here at least suggest that more objective measures of muscular tension might contribute significantly to the prediction of teacher performance in the classroom.

The Prediction of Student Teacher Performance.

Although an analysis of data for drop-outs against those for continuing students was planned, the sample provided only 10 drop-outs. Of this group physiological data for four had been excluded from the analysis because of respiratory infections, medication, or high sublingual temperature. The remaining drop-out N of 6 was considered too small for analysis. Their data will be treated in connection with the follow-up study of in-service teaching.

The pilot study therefore provides little data for determining the value of the tests in the prediction of emotional stability or instability associated with teaching. It does provide preliminary information concerning the value of the tests in the prediction of student teacher performance. The basic data are the correlation coefficients against the two major criterion variables TR_m and UR which have been presented in Tables P, Q, and R. Although the correlation coefficients are low, it must be remembered that the intercorrelations among the physiological variables are also low. Their magnitude, therefore, does not preclude their use in the prediction of teacher performance. To this end selected multiple correlations were computed and regression equations obtained. They appear in Table S.

Theoretically, the use of all variables that correlate with a criterion variable should provide the largest multiple correlation. In practice, those with coefficients less than .10 contribute little except more complex equations. For our present purposes, then, we employed only those physiological and psychological variables that correlated .10 or higher with criterion variables TR_m and UR. The resulting multiple r's appear at the bottom of the first and third columns of Table S, and are seen to be .51 and .50 respectively.

It is not surprising that the test battery cannot be employed successfully in predicting student teacher performance for individuals. It is clear, however, that it can be used for group predictions. Of more significance is the inference that some of the tests will supplement the COR and UR evaluations for the prediction of in-service

Table S

MULTIPLE CORRELATION COEFFICIENTS AND BETA WEIGHTS FOR PREDICTING MAJOR CRITERION VARIABLES FROM SELECTED PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES

	Beta weights				
Variables	TR$_m$	TR$_m$	UR	UR	TR$_o$
Salivary output	.11	-.12			-.11
Finger temperature (2)	-.15	-.15	-.05	-.08	-.15
Axillary temperature	-.17	-.18			-.14
Sublingual temperature			-.08	-.06	
Dermographia persistence			-.11	-.15	
Respiration Period					-.13
Pupillary Diameter					-.16
Muscle tension mean	-.18	-.20	-.17	-.22	-.16
G-Z Scale S	.32	.31	.30	.28	.13
Systolic blood pressure reaction			-.11		
Heart rate reaction			-.08		
Respiration rate reaction	-.13		-.12		
Axillary temperature reaction	.03		.07		
Finger temperature reaction	.12				
Multiple r	.51	.48	.50	.43	.40

teacher performance. None of the present tests alone correlated more than .33 with UR nor more than .30 with TR_m, yet, as a group, they can predict either UR or TR_m almost as well as either can be predicted from the other.

A multiple correlation of the test battery with TR_o also was obtained because, as was pointed out in the introduction to this section, it seemed possible that TR_o showed closer relationships to some of the tests than did TR_m or UR. It showed no significant relationships, however, to the measures of physiological reactivity so the obtained multiple r of .40 was based only upon the pre-stimulus physiological measures, the G-Z scale, and the mean muscle tension rating. Similar variables were utilized in other multiple correlations against TR_m and UR. They are shown at the bottom of columns two and four of Table S. Although the reduced equations provide reduced predictive capacity, it is of interest that the reduction is least for the criterion we regard as "best" (TR_m); the multiple r for only five variables was .48.

6. DISCUSSION AND CONCLUSIONS

This study has sought to test the following hypotheses:

(A) Individual differences in autonomic response patterns furnish a basis for the prediction of those individuals who cannot well withstand the stress of teaching and those who may develop specific psychosomatic and other psychological disorders.

(B) Measures of autonomic functions will improve the predictive value of psychological correlates of teacher performance.

There is reason to believe that the results afford some support for the second hypothesis. Since so few subjects dropped out of student teaching this study can afford no test of the first hypothesis until extended follow-up studies now under way are completed.

There are two major contributions of the study. First, a pool of data which we believe worthy of validation against in-service teacher performance has been collected. Second, the investigation of autonomically innervated functions in young adult females provides a new body of information which will have many applications.

The study, as originally proposed, provided for three years of testing and three years of evaluation of in-service teacher performance, with an anticipated N of 1800. In the present pilot study 279 subjects were tested between October 27, 1959, and August 17, 1960. The only criterion variables to be reported at this time are evaluations of supervised student teacher - variables that we believe should be regarded as potential predictors, not validation criteria.

For these 279 subjects, adequate physiological data were obtained for 247, and adequate psychological data and evaluations of student teacher performance were obtained for somewhat smaller numbers. Funds have been made available for an initial follow-up evaluation of these subjects during the first year of in-service teaching. It is hoped that additional evaluations beyond this period can be obtained. Only as stresses accumulate and attrition occurs will it be possible to test the hypotheses which induced this study. Only later, then, can the value of this study for education be assessed.

Immediate values are present, however, for basic science. The contributions may be summarized as follows:

(A) Normative data on autonomic functions in adult females. This study constitutes the first extensive investigation of autonomically innervated functions in an adult female population. The means and standard deviations provide a body of data which can be employed by other investigators for comparative purposes in psychophysiological research. As one illustration of the value of such normative data, it may be pointed out that comparable data for adult males (Wenger, 1948) have now been employed in over a score of comparative investigations, and have served to stimulate such research. There is every reason to believe that the physiological data of the present study will serve similar ends.

(B) Transformations and corrections of physiological data. This study has provided the largest sample yet available in terms of which to investigate the need for transformations and corrections of continuously recorded physiological data. As reported in Section 3, it proved necessary to transform the distributions for some variables, and to correct every variable for the effects of one or more uncontrolled variables. Such findings will sadden many investigators, but they cannot go unheeded. They suggest that a series of similar investigations should be initiated in many laboratories to determine what transformations and corrections are needed for particular samples in particular situations. The results point up the need for caution in the evaluation of studies that have neglected these considerations.

(C) The factorial analyses. This study also has pioneered in the factorial investigation of physiological measurements in female adults. Although some of the obtained factors are not readily identifiable, a general factor of autonomic function has been described, and an equation presented for its estimation. A new research tool is thereby provided. It may be expected to stimulate further research with female subjects.

Three other contributions should be mentioned. Although we do not regard the so-called "criterion variables" of this pilot study as adequate criteria of teaching performance, they probably are related to it. This study then permits the following conclusions:

(1) Scores on the Guilford-Zimmerman Scale S are positively related to teaching performance;

(2) Characteristic level of muscular tension is negatively related to teaching performance;

(3) Finger temperature is positively related to teaching performance; other physiological measurements also may be related.

These conclusions are derived from the statistics presented in

Table S and from the inter-correlations shown in Table O among the University Ratings (UR), and the total mean Classroom Observation Ratings (TR_M), and the total COR of the outside observers (TR_O). Although TR_M and UR correlate .65, much of the covariance may be attributed to the fact that the supervisors were solely responsible for UR and contributed to TR_M. Thus a better index of true common variance between the two kinds of evaluations is obtained from the correlation of .36 between UR and TR_O. When different raters use different instruments yet obtain evaluations that tend to covary, it seems reasonable to assume that this common variance is related to teaching performance and that other variables which are related to both UR and TR_O also are related to teaching performance.

Three variables are seen in Table S to satisfy this criterion. One, the mean muscle tension rating, may be seen in Table R to have demonstrated significant correlations with all criterion variables, while the other two - G-Z scale S and the second measure of finger temperature (see Tables R and P) show the next greatest number of significant relationships.

The Guilford-Zimmerman Scale S scores represent self-evaluations of the trait of social participation or sociability. The results suggest that those who so rate themselves high on this scale also appear to be more sociable to observers, and that such a trait enters into ratings of teaching behavior. Such a possible halo effect, however, does not minimize the significance of this scale as one measure in a test battery for the prediction of teacher behavior.

More certainly suspect for halo effect are the ratings of muscle tension which, for the outside observers at least, were based on the same observation periods that made possible the TR_O ratings. The general relationship of the mean tension ratings to all criterion variables suggests, however, that this variable deserves further study.***

The third variable, finger temperature, has a less clearly defined relationship to supervisors' ratings than it has to those of the outside observers, but again it seems worthy of further study.

Concerning the other physiological variables which appear in Table S, it can only be said that they have some value for predicting TR_O, TR_M, or UR, and should not be neglected in further studies on prediction of teacher performance.

Regardless of the possible contributions of other variables, it may be of interest to point out that the three variables mentioned in the foregoing paragraphs may be used with some success in the prediction of student teaching performance. Their multiple correlations with the

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***One step in this direction has already been taken. As a result of the relationships found between muscle tension and teacher performance, Miss Iris Balshan, a research assistant on this project, conducted her doctoral dissertation in such a manner as to provide a test of this possible relationship which would be free of halo effect. (Iris Dale Balshan, A Factorial Study of Muscle Tension and Personality in Women. Unpublished doctoral dissertation, University of California, Los Angeles, 1961). Her investigation tested the hypothesis that a general factor of muscular tension exists in young adult females, with muscle tension being measured in terms of action potentials from sixteen muscle groups. Miss Balshan was influenced to select her subjects from elementary teacher candidates. Her results were positive and provided a regression equation in terms of which a general muscle tension factor was estimated for each subject.

These data are now available to the project director of the present study and will be employed as additional data in the follow-up investigation now under way.

three criteria considered in Table S are shown in the following tabulation:

	TR_m	TR_o	UR
G-Z Scale S Mean muscle tension Finger temperature	.40	.27	.40

Although the multiple correlations are not quite as high as those shown in Table S they do permit one to characterize groups of good student teachers as relaxed, sociable, and possessing high finger temperature. Such a picture is not unreasonable. Perhaps it will obtain also, for good in-service teachers. We venture to predict, however, that ability to withstand the daily and accumulative stress of in-service teaching will involve other variables that we have studied, and, in particular, estimates of the autonomic factor.

Before concluding this discussion it should be mentioned that time and funds have not permitted analysis of two classes of data available in this study. One concerns rate of recovery from cold pressor stimulation. The other involves differential patterns of autonomic responses. Both of these forms of data will be considered in the follow-up studies now under way.

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APPENDIX A

INDIVIDUAL SUBJECT DATA-RECORDING FORM

NAME ____________ No. ______ DATE __________ EXPERIMENT __________

Time of Measurement ____________ Room Temperature ________ RS SS Wt.

SO milliliters (cc.) output for 3 minute sample . . . . ______ ______ .14

ST ______ degrees fahrenheit plus ____ correction (Table VI) . . ______ ______ * .30

PC Sample at end of 1st and 2nd minutes, standing

1. ______ 2. ______ volts

1. ______ 2. ______ micromhos conductance. Average . . . . . ______ ______ * .09

VC Samples at end of 1st and 2nd minutes, standing

1. ______ 2. ______ 3. ______ 4. ______ K ohms resistance

Lowest conductance______micromhos plus______correction (Table V) ______ ______ *.09

LCC Samples of reclining PC at 3 minute intervals

1. ______ 2. ______ 3. ______ 4. ______ K ohms resistance

Strain ______ volts = ______ log micromhos conductance

minus lowest resting conductance______ log micromhos . . . . . ______ ______ .17

DBP Samples at 3 minute intervals, reclining

Systolic: 1. ______ 2. ______ 3. ______ 4. ______ mm. Hg.

Diastolic: 1. ______ 2. ______ 3. ______ 4. ______ mm. Hg.

Average of the 2 DBPs accompanying 2 lowest SBPs . . . . ______ ______ * .18

HP Samples at 3 minute intervals, reclining

1. ____ 2. ____ 3. ____ 4. ____ cycles per min.

1. ____ 2. ____ 3. ____ 4. ____ millimin./10 cycles Av. . . . . ______ ______ .41

Milliminutes per 10 cycles = 10,000/cycles min. A score ______

SBP Average of 2 lowest SBPs ____ plus ____ correction (Table VI) ______ ______ *

PP RS entry for SBP minus RS entry for DBP . . . . ______ ______

First FiT ______ C. + ______ C. correction (Table VI) . . . . ______ ______

Second FiT ______ C. + ______ C. correction (Table VI) . . . . ______ ______

DL seconds . . . . ______ ______ *

DP minutes . . . . ______ ______

PD average of two consistent measurements . . . . ______ ______ *

RP Samples at 3 minute intervals, reclining

1. ____ 2. ____ 3. ____ 4. ____ seconds per cycle Av. . . . . . ______ ______

* Asterisk indicates reflected standard score.

APPENDIX B

KEY FOR INDIVIDUAL SUBJECT DATA-RECORDING FORM

SO ....Salivary Output

ST ....Sublingual Temperature

PC ....Palmar Conductance

VC ....Volar Conductance

LC ....Log Conductance

DBP ....Diastolic Blood Pressure

HP ....Heart Period

SBP ....Systolic Blood Pressure

PP ....Pulse Pressure

First FiT.............First Finger Temperature

Second FiT...........Second Finger Temperature

DL ....Dermographia Latency

PD ....*Pupillary Diameter*

RP ....Respiration Period

SCALE FOR RATING CHARACTERISTIC LEVEL OF MUSCULAR TENSION

INSTRUCTIONS TO RATER: Wait until you have observed the subject for two weeks before you attempt to rate him. Do not discuss this scale with the subject.

Try to picture the subject in non-emotional situations, and exclude the factor of restlessness as much as possible. If he is relaxed, he appears to move freely; his arms and hands give the impression of just "hanging"; his face is rather blank and immobile. If he is tense, his movements are more jerky, more "massive" in the sense of a "tight" body reacting as an uncoordinated whole, or set ready to react at the slightest provocation. His face is not impassive. It and his whole body give an impression of strain.

Characteristic tension of the skeletal muscles is a variable which may be separated from emotional behavior and from restlessness. Although emotion includes muscular tension, tension may be present in the absence of emotion. Although restlessness is based on a certain amount of residual tension, the extremely tense individual may inhibit restlessness while the relatively relaxed person may be freer to show some restlessness.

TO MAKE YOUR RATING, PLACE A CHECK MARK AT THE MOST APPROPRIATE POINT ON THE X LINE BELOW, BUT DO NOT PLACE YOUR MARK AT THE DOTTED LINES. PLACE IT SOMEWHERE BETWEEN THE DOTTED LINES. IF YOU CANNOT BE SURE OF YOUR RATING, GUESS. DON'T RATE HIM AS AVERAGE UNLESS YOU BELIEVE HE TRULY IS AVERAGE.

X

______ Tense. Seems never to relax and take things easy. Looks and acts as though under constant muscular strain.

....

....

______ Usually tense. Movements are often jerky, uneven.

....

....

______ Just average. Cannot be described as either tense or relaxed.

....

....

______ Relaxed, but not sleepy. Movements easy and "loose"; rather limp.

....

....

______ So relaxed he looks and acts almost asleep.

....

X

Name of Subject______________________________ Class____________________

Name of Rater______________________ School__________________ Date______

APPENDIX D

CLASSROOM OBSERVATION RECORD

Teacher________________________________Class or Subject__________________Date_______

City______________________________School_______________Time________Observer___________

PUPIL BEHAVIOR (Circle one only) **REMARKS:**

1.	Apathetic	1	2	3	4	5	6	7	N	Alert
2.	Obstructive	1	2	3	4	5	6	7	N	Responsible
3.	Uncertain	1	2	3	4	5	6	7	N	Confident
4.	Dependent	1	2	3	4	5	6	7	N	Initiating

TEACHER BEHAVIOR (Circle one only)

5.	Partial	1	2	3	4	5	6	7	N	Fair
6.	Autocratic	1	2	3	4	5	6	7	N	Democratic
7.	Aloof	1	2	3	4	5	6	7	N	Responsive
8.	Restricted	1	2	3	4	5	6	7	N	Understanding
9.	Harsh	1	2	3	4	5	6	7	N	Kindly
10.	Dull	1	2	3	4	5	6	7	N	Stimulating
11.	Stereotyped	1	2	3	4	5	6	7	N	Original
12.	Apathetic	1	2	3	4	5	6	7	N	Alert
13.	Unimpressive	1	2	3	4	5	6	7	N	Attractive
14.	Evading	1	2	3	4	5	6	7	N	Responsible
15.	Erratic	1	2	3	4	5	6	7	N	Steady
16.	Excitable	1	2	3	4	5	6	7	N	Poised
17.	Uncertain	1	2	3	4	5	6	7	N	Confident
18.	Disorganized	1	2	3	4	5	6	7	N	Systematic
19.	Inflexible	1	2	3	4	5	6	7	N	Adaptable
20.	Pessimistic	1	2	3	4	5	6	7	N	Optimistic
21.	Immature	1	2	3	4	5	6	7	N	Integrated
22.	Narrow	1	2	3	4	5	6	7	N	Broad

N means not observed

GLOSSARY

APPENDIX E

(To be used with Classroom Observation Record)

Pupil Behaviors

1. Apathetic-Alert Pupil Behavior

Apathetic	Alert
1. Listless.	1. Appear anxious to recite and participate.
2. Bored-acting.	2. Watch teacher attentively.
3. Enter into activities half-heartedly.	3. Work concentratedly.
4. Restless.	4. Seem to respond eagerly.
5. Attention wanders.	5. Prompt and ready to take part in activities when they begin.
6. Slow in getting underway	

2. Obstructive-Responsible Pupil Behavior

Obstructive	Responsible
1. Rude to one another and/or to teacher.	1. Courteous, cooperative, friendly with each other and with teacher.
2. Interrupting; demanding attention; disturbing.	2. Complete assignments without complaining or unhappiness.
3. Obstinate; sullen.	3. Controlled voices.
4. Refusal to participate.	4. Received help and criticism attentively.
5. Quarrelsome; irritable.	5. Asked for help when needed.
6. Engaged in name-calling and/or tattling.	6. Orderly without specific directions from teacher.
7. Unprepared.	7. Prepared.

3. Uncertain-Confident Pupil Behavior

Uncertain	Confident
1. Seem afraid to try; unsure.	1. Seem anxious to try new problems or activities.
2. Hesitant; restrained.	2. Undisturbed by mistakes.
3. Appear embarrassed.	3. Volunteer to recite.
4. Frequent display of nervous habits, nail-biting, etc.	4. Enter freely into activities.
5. Appear shy and timid.	5. Appear relaxed.
6. Hesitant and/or stammering speech.	6. Speak with assurance.

4. Dependent-Initiating Pupil Behavior

Dependent	Initiating
1. Rely on teacher for explicit directions.	1. Volunteer ideas and suggestions.
2. Show little ability to work things out for selves.	2. Showed resourcefulness.
3. Unable to proceed when initiative called for.	3. Take lead willingly.
4. Appear reluctant to take lead or to accept responsibility.	4. Assume responsibilities without evasion.

Teacher Behaviors

5. Partial-Fair Teacher Behavior

Partial	Fair
1. Repeatedly slighted a pupil.	1. Treated all pupils approximately equally.
2. Corrected or criticized certain pupils repeatedly.	2. In case of controversy pupil allowed to explain his side.
3. Repeatedly gave a pupil special advantages.	3. Distributed attention to many pupils.
4. Gave most attention to one or a few pupils.	4. Rotated leadership impartially.
5. Showed prejudice (favorable or unfavorable) towards some social, racial or religious groups.	5. Based criticism or praise on factual evidence, not hearsay.
6. Expressed suspicion of motives of a pupil.	

6. Autocratic-Democratic Teacher Behavior

Autocratic	Democratic
1. Tells pupils each step to take.	1. Guided pupils without being mandatory.
2. Intolerant of pupils' ideas.	2. Exchanged ideas with pupils.
3. Mandatory in giving directions; orders to be obeyed at once.	3. Encouraged (asked for) pupil opinion.
4. Interrupted pupils although their discussions was relevent.	4. Encouraged pupils to make own decisions.
5. Always directed rather than participated.	5. Entered into activities without domination.

7. Aloof-Responsive Teacher Behavior

Aloof	Responsive
1. Stiff and formal in relations with pupils.	1. Approachable to all pupils.
2. Apart; removed from class activity.	2. Participates in class activity.
3. Condescending to pupils.	3. Responded to reasonable requests and/or questions.
4. Routine and subject-matter only concern; pupils as persons ignored.	4. Speaks to pupils as equals.
5. Referred to pupils as "this child" or "that child."	5. Commends effort.
	6. Gives encouragement.
	7. Recognized individual differences.

8. Restricted-Understanding Teacher Behavior

Restricted	Understanding
1. Recognized only academic accomplishments of pupils; no concern for personal problems.	1. Showed awareness of a pupil's personal emotional problems and needs.
2. Completely unsympathetic with a pupil's failure at a task.	2. Was tolerant of error on part of pupil.
3. Called attention only to very good or very poor work.	3. Patient with a pupil beyond ordinary limits of patience.
4. Was impatient with a pupil.	4. Showed what appeared to be sincere sympathy with a pupil's viewpoint.

9. Harsh-Kindly Teacher Behavior

Harsh

1. Hypercritical; fault-finding.
2. Cross; curt.
3. Depreciated pupil's efforts; was sarcastic.
4. Scolds a great deal.
5. Lost temper.
6. Used threats.
7. Permitted pupils to laugh at mistakes of others.

Kindly

1. Goes out of way to be pleasant and/or to help pupils; friendly.
2. Gave a pupil a deserved compliment.
3. Found good things in pupils to call attention to.
4. Seemed to show sincere concern for a pupil's personal problem.
5. Showed affection without being demonstrative.
6. Disengaged self from a pupil without bluntness.

10. Dull-Stimulating Teacher Behavior

Dull

1. Uninteresting, monotonous explanations.
2. Assignments provide little or no motivation.
3. Fails to provide challenge.
4. Lack of animation.
5. Failed to capitalize on pupil interests.
6. Pedantic, boring.
7. Lacks enthusiasm; bored acting.

Stimulating

1. Highly interesting presentation; gets and holds attention without being flashy.
2. Clever and witty, though not smart-alecky or wise-cracking.
3. Enthusiastic; animated.
4. Assignments challenging.
5. Took advantage of pupil interests.
6. Brought lesson successfully to a climax.
7. Seemed to provoke thinking.

11. Stereotyped-Original Teacher Behavior

Stereotyped

1. Used routine procedures without variation.
2. Would not depart from procedure to take advantage of a relevent question or situation.
3. Presentation seemed unimaginative.
4. Not resourceful in answering questions or providing explanations.

Original

1. Used what seemed to be original and relatively unique devices to aid instruction.
2. Tried new materials or methods.
3. Seemed imaginative and able to develop presentation around a question or situation.
4. Resourceful in answering questions; had many pertinent illustrations available.

12. Apathetic-Alert Teacher Behavior

Apathetic

1. Seemed listless; lanquid; lacked enthusiasm.
2. Seemed bored by pupils.
3. Passive in response to pupils.
4. Seemed preoccupied.
5. Attention seemed to wander.
6. Sat in chair most of time; took no active part in class activities.

Alert

1. Appeared buoyant; wide-awake; enthusiastic about activity of the moment.
2. Kept constructively busy.
3. Gave attention to, and seemed interested in, what was going on in class.
4. Prompt to "pick up" class when pupils' attention showed signs of lagging.

Teacher Behaviors (Cont.)

13. Unimpressive-Attractive Teacher Behavior

Unimpressive

1. Untidy or sloppily dressed.
2. Inappropriately dressed.
3. Drab, colorless.
4. Posture and bearing unattractive.
5. Possessed distracting personal habits.
6. Mumbled; inaudible speech; limited expression disagreeable voice tone; poor inflection.

Attractive

1. Clean and Neat.
2. Well-groomed; dress showed good taste.
3. Posture and bearing attractive.
4. Free from distracting personal habits.
5. Plainly audible speech; good expression; agreeable voice tone; good inflection.

14. Evading-Responsible Teacher Behavior

Evading

1. Avoided responsibility; disinclined to make decisions.
2. "Passed the buck" to class, to other teachers, etc.
3. Left learning to pupil, failing to give adequate help.
4. Let a difficult situation get out of control.
5. Assignments and directions indefinite.
6. No insistance on either individual or group standards.
7. Inattentive with pupils.
8. Cursory.

Responsible

1. Assumes responsibility; makes decisions as required.
2. Conscientious.
3. Punctual.
4. Painstaking; careful.
5. Suggested aids to learning.
6. Controlled a difficult situation.
7. Gave definite directions.
8. Called attention to standards of quality.
9. Attentive to class.
10. Thorough.

15. Erratic-Steady Teacher Behavior

Erratic

1. Impulsive; uncontrolled; temperamental; unsteady.
2. Course of action easily swayed by circumstances of the moment.
3. Inconsistent.

Steady

1. Calm; controlled.
2. Maintained progress toward objective.
3. Stable, consistent, predictable.

16. Excitable-Poised Teacher Behavior

Excitable

1. Easily disturbed and upset; flustered by classroom situation.
2. Hurried in class activities; spoke rapidly using many words and gestures.
3. Was "jumpy"; nervous.

Poised

1. Seemed at ease at all times.
2. Unruffled by situation that developed in classroom; dignified without being stiff or formal.
3. Unhurried in class activities; spoke quietly and slowly.
4. Successfully diverted attention from a stress situation in classroom.

Teacher Behaviors (Cont.)

17. Uncertain-Confident Teacher Behavior

Uncertain

1. Seemed unsure of self; faltering, hesitant.
2. Appeared timid and shy.
3. Appeared artificial.
4. Disturbed and embarrassed by mistakes and/or criticism.

Confident

1. Seemed sure of self; self-confident in relations with pupils.
2. Undisturbed and unembarrassed by mistakes and/or criticism.

18. Disorganized-Systematic Teacher Behavior

Disorganized

1. No plan for class-work.
2. Unprepared.
3. Objectives not apparent; undecided as to next step.
4. Wasted time.
5. Explanations not to the point.
6. Easily distracted from matter at hand.

Systematic

1. Evidence of a planned though flexible procedure.
2. Well prepared.
3. Careful in planning with pupils.
4. Systematic about procedure of class.
5. Had anticipated needs.
6. Provided reasonable explanations.
7. Held discussion together; objectives apparent.

19. Inflexible-Adaptable Teacher Behavior

Inflexible

1. Rigid in conforming to routine.
2. Made no attempt to adapt materials to individual pupils.
3. Appeared incapable of modifying explanation or activities to meet particular classroom situations.
4. Impatient with interruptions and digressions.

Adaptable

1. Flexible in adapting explanations.
2. Individualized materials for pupils as required; adapted activities to pupils.
3. Took advantage of pupils' questions to further clarify ideas.
4. Met an unusual classroom situation competently.

20. Pessimistic-Optimistic Teacher Behavior

Pessimistic

1. Depressed; unhappy
2. Skeptical
3. Called attention to potential "bad."
4. Expressed hopelessness of "education today," the school system, or fellow educators.
5. Noted mistakes; ignored good points.
6. Frowned a great deal; had unpleasant facial expression.

Optimistic

1. Cheerful; good natured.
2. Genial.
3. Joked with pupils on occasion.
4. Emphasized potential "good."
5. Looked on bright side; spoke optimistically of the future.
6. Call attention to good points; emphasized the positive.

Teacher Behaviors (Cont.)

21. Immature-Integrated Teacher Behavior

Immature

1. Appeared naive in approach to classroom situations.
2. Self-pitying; complaining; demanding.
3. Boastful; conceited.

Integrated

1. Maintained class as center of activity; kept self out of spotlight; referred to class's activities, not own.
2. Emotionally well controlled.

22. Narrow-Broad Teacher Behavior

Narrow

1. Presentation strongly suggested limited background in subject or material; lack of scholarship
2. Did not depart from text.
3. Failed to enrich discussions with illustrations from related areas.
4. Showed little evidence of breadth of cultural background in such areas as science, arts, literature and history.
5. Answers to pupils' questions incomplete or inaccurate.
6. Non-critical approach to subject.

Broad

1. Presentation suggested good background in subject; good scholarship suggested.
2. Drew examples and explanations from various sources and related fields.
3. Showed evidence of broad cultural background in science, art, literature, history, etc.
4. Gave satisfying, complete, and accurate answers to questions.
5. Was constructively critical in approach to subject-matter.

APPENDIX F

UNIVERSITY OF CALIFORNIA – LOS ANGELES
RATING SCALE FOR STUDENT TEACHING – ELEMENTARY SCHOOL

	F	D	C	B	A
A. PERSONAL CHARACTERISTICS					
1. **PHYSICAL HEALTH AND VITALITY** – (vigorous, good posture, free of illness).					
2. **EMOTIONAL MATURITY**					
a. poise, self-control, free from shyness and offensive aggressiveness.					
b. meets unexpected and changing situation with decision and good judgment.					
3. **APPEARANCE** – (neat, well-groomed, dresses appropriately and in good taste, appears refined).					
4. **CHARACTER AND INTEGRITY** – (good sense of values, trustworthy)					
5. **PERSONALITY CHARACTERISTICS**					
a. Uses courtesy and tact in all relationships.					
b. Creativity					
c. Initiative					
6. **VOICE AND SPEECH** (pleasant, flexible, clear, effective, adapted to purpose and situation)					
7. **ACADEMIC PROFICIENCY** – a. Understanding basic subject matter, b. Proficiency in verbal and written expression. a.					
b.					
B. PROFESSIONAL COMPETENCE					
8. **CLASSROOM ARRANGEMENT** – (attends to lighting, ventilation, seating, neat, attractive, functional room)					
9. **MANAGEMENT OF CLASSROOM ROUTINE** – (orderly, prompt, effective routines, involving pupil participation)					
10. **DISCIPLINE**					
a. Guides pupils to formulate and maintain desirable standards.					
b. Consistently emphasizes the positive.					
c. Builds responsible self-control.					
d. Is sympathetic and objective when dealing with undesirable behavior.					
e. Provides dynamic, inspirational leadership.					
11. **PRINCIPLES OF LEARNING**					
a. Emphasizes purposeful experience and intrinsic motivation.					
b. Plans and evaluates cooperatively with children.					
c. Meets each child's needs for acceptance, security, success, recognition, and valid praise.					
d. Provides effective review, practice and drill, keeping these subordinate to understanding.					
e. Promotes total group participation.					
12. **CHILD DEVELOPMENT**					
a. Understanding of developmental level of pupils and developmental tasks confronting them.					
b. Plans differentiated activities and standards to meet individual needs.					
c. Adapts procedures to the responses of his pupils. (Resourcefulness and flexibility)					
d. Takes into account the pressures on children from the peer culture, home, and community.					
e. Maintains positive rapport and good emotional atmosphere.					
13. **PLANNING**					
a. Defines worthwhile objectives for large units and daily classwork.					
b. Organizes his teaching by careful choice and sequence of experiences, content, and materials.					
c. Uses a wide variety of materials of instruction.					
14. **TEACHING PROCEDURES**					
a. Provides for pupil participation in purposing, planning, executing and evaluating.					
b. Makes skillful use of guiding questions.					
c. Develops pupils' study and problem-solving skills.					
d. Stimulates creative responses.					
15. **USE OF DIAGNOSTIC AND REMEDIAL MEASURES.** (Helps pupils find own errors and needs, and helps to meet these)					
16. **ACHIEVING RESULTS**					
a. Carries plans through to successful conclusion.					
b. Is able to communicate ideas to children.					
c. Is able to demonstrate vividly and effectively.					
d. Children evidence growth in school subjects and social habits.					
17. **EVALUATION OF PUPIL ACHIEVEMENT** – (uses formal and informal means of measuring growth)					
18. **PROFESSIONAL ETHICS**					
a. Works harmoniously and cooperatively with peers.					
b. Works effectively toward common goals with supervisors.					
c. Evidences professional attitudes.					
19. **EVALUATION AND GROWTH**					
a. Assumes responsibility for continued professional growth.					
Analyzes own strengths and weaknesses in order to effect continuous improvement.					
c. Is sensitive to pupils' reactions, needs, and difficulties as a basis for evaluating success.					
20. **PROMISE OF FUTURE GROWTH AND SUCCESS.**					
a. Is likely to continue personal and professional growth.					
b. Fulfills obligations.					
c. Evidences independence by latter part of the assignment.					
Total number of checks by column					
Score value	1	2	3	4	5
Score (score value of each column times number of checks)					
Average score (sum of scores divided by total checks)					

A = 4.6 – 5.0
B = 3.6 – 4.5
C = 2.5 – 3.5
D = 1.5 – 2.4
F = 1.0 – 1.4

FINAL GRADE ____________

APPENDIX G

A Description of the Guilford-Zimmerman Temperament Survey Traits**

G = General Activity: Liking for speed, energy, production, efficiency vs. slow and deliberate, inefficient, easily fatigued.

R = Restraint: Serious-minded, persistent, deliberate vs. impulsive, carefree, excitement-loving.

A = Ascendence: Leadership, self-defense, persuading others, bluffing vs. submissiveness, following, hesitation.

S = Sociability: Having many friends, seeking social contacts and limelight vs. having few friends, shyness.

E = Emotional Stability: Eveness of moods, optimism, good health vs. fluctuation of moods, pessimism, guilt, loneliness, daydreaming.

O = Objectivity: Thick-skinned vs. hypersensitive, self-centered, suspicious, getting into trouble.

F = Friendliness: Toleration of hostile action, respect for others vs. belligerence, hostility, contempt for others, desire to dominate.

T = Thoughtfulness: Reflective, observing of self and others vs. interest in overt activity, mental disconcertedness.

P = Personal Relations: Tolerance of people, faith in social institutions vs. fault-finding, suspiciousness, self-pitying.

M = Masculinity: Interest in masculine activities, hard-boiled, inhibition of emotional expression vs. interest in feminine activities, sympathetic, fearful, emotionally expressive.

**Summarized from: J. P. Guilford and Wayne S. Zimmerman, The Guilford-Zimmerman Temperament Survey: Manual of Instructions and Interpretations. Beverly Hills, California: Sheridan Supply Company, 1949. 12 pages.

Department of Education, U.C.L.A.
Room 1020, University Elementary School

INSTRUCTION SHEET

The research study in which you will participate is sponsored by the U. S. Office of Education. At present it is concerned with obtaining normative data for a large number of women in professional education. As a future member of the profession of education we believe you will find the research procedures an interesting and valuable experience. Your participation in the study will add to the over-all group data and you will be making a worthy contribution to knowledge in the field of teacher education. None of the research data will appear on university records nor will it be available to persons outside the research staff. The laboratory center is in the charge of Mrs. Sommer and three women assistants. Your visit to the research center will require about 1 1/2 hours, but you should allow about two hours to reach the center and return.

You will be requested to sign up on an APPOINTMENT SHEET which will be circulated each week in this class until all members of the class have had the opportunity to complete their appointments. Only one appointment will be required. Because of the kinds of measures which will be obtained it is necessary that you observe the following instructions before you come to the center in Room 1020, University Elementary School.

1. Remember the verbal instructions given to you in your education class by Mrs. Sommer regarding an appropriate time for your appointment.

2. Get an average satisfactory amount of sleep the night before the appointment.

3. Do not take any drugs (medications) or alcohol for a twenty-four hour period preceding the appointment.

4. Do not take food, coffee, tea, or coca-cola for at least two hours preceding the appointment.

5. Do not smoke or drink water for at least 1/2 hour preceding the appointment.

At the time of your appointment please report to Room 1020 at the University Elementary School. The University Elementary School is north of the Women's Gymnasium. Follow the walk to the Elementary School playground and follow the outside corridor of the main building, turn left in the main building and Room 1020 is just inside, opposite the children's library.

Broken appointments make it extremely difficult for the staff to maintain a schedule, however should you be unable to keep your scheduled appointment please advise Mrs. Shirley Fisher, Room 231, Moore Hall - Campus, or phone Mrs. Fisher at GRanite 3-0971, extension 269 or 418.

10/59/WHL
Project No. 648
SAE 8311

APPENDIX I

SUPPLEMENTARY DATA FORMS

SMOKING QUESTIONNAIRE

1. Do you smoke? Yes ______ No ______
2. If so, approximately how many cigarettes per day? ______
3. Do you inhale? Never ______ Sometimes ______
   Usually ______ Always ______
4. Preferred brand of cigaretts? ______
5. Do you recall the time of your last cigarette before you took part in the laboratory measurements? ______

DATA ON MENSTRUAL CYCLE (Obtained by women laboratory technicians)

1. Date of onset of last menstrual period? ______
2. Date of end of last menstrual period? ______
3. Usual length of period? ______
4. Usual length of cycle? ______
5. Regular? If not, how irregular? How many days late, if ever? Are periods skipped or do you menstruate once every month?
6. Any dismenorrhea? Before? During? Or After? What kind? ("Cramps"--slight first day? Backache, headache, fatigue, and so on)
7. Eye color

PERSONAL INFORMATION (Obtained by women laboratory technicians)

1. Name: Last, First, Middle. TEST NUMBER ______
2. Address: City, Telephone. DATE AND TIME OF TEST ______
3. Date of Birth
4. Height, weight
5. Academic Level in the University (junior, senior, graduate)
6. Specific class in teacher education, section.
7. Miscellaneous: colds, infections, taking medication, recent hospitalization, and so on.

APPENDIX J

STUDIES OF AUTONOMIC RESPONSE PATTERNS: RATIONALE AND METHODS[1]

Wenger, M. A., Engel, B. T., and Clemens, T. L.

Department of Psychology, University of California, Los Angeles

In 1939 the senior author and his associates initiated work designed to test the following restatement of the Eppinger and Hess hypothesis (3):

> "The differential chemical reactivity and the physiological antagonism of the adrenergic and cholinergic branches of the autonomic nervous system permit of a situation in which the action of one branch may predominate over that of the other. This predominance, or autonomic imbalance, may be phasic or chronic, and may obtain for either the adrenergic or the cholinergic system. Autonomic imbalance, when measured in an unselected population, will be distributed continuously about a central tendency which shall be defined as autonomic balance." (5)

The work involved the measurement of a number of autonomically innervated functions in a population of children, the intercorrelation and factorial analysis of the data, and the estimation of the obtained autonomic factor for the individual children. Such factor estimates were called "Scores of Autonomic Balance," and their distribution was found to be approximately normal. It was concluded that the original Eppinger and Hess hypothesis was supported, and that it fitted the obtained results better than did the restatement; i.e., the obtained factor could more logically be interpreted as a sympathetic-parasympathetic continuum than as representing relative dominance of adrenergic or cholinergic divisions.

Further studies with children (6, 7, 10) and with adults (8) led to the following conclusions:

(1) Individual differences in autonomic functioning during controlled rest exist in both children and adults.

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[1] This investigation was supported (in part) by research grant M788 from the Institute of Mental Health, National Institutes of Health, Public Health Service.

As published by Behavioral Science, 1957, 2, 216-221.

(2) These differences, measured in terms of an autonomic factor, are continuously distributed and are presumed to be normally distributed in an unselected population. Vagotonia and sympathicotonia, as described by Eppinger and Hess, are regarded as representing extremes on such a continuum.

(3) The autonomic factor for a given individual tends to remain constant from year to year, but it may be altered phasically or chronically by changes in external or internal stimulation.

(4) Autonomic factor scores are related to certain personality patterns and to certain diagnostic categories, such as anxiety psychoneurosis, battle fatigue, and asthma.

(5) Autonomic factor scores do not necessarily reflect a consistent pattern of autonomic balance or imbalance. That is, some individuals demonstrate autonomic patterns wherein some functions suggest an apparent dominance of the sympathetic branch and others indicate an apparent dominance of the parasympathetic branch. Individual differences in patterns of action, therefore, are considered to be significant.

(6) Autonomic factor scores from resting data are not necessarily related to autonomic reactivity under stimulation.

The last conclusion was based on a study, not yet published, which found that frequencies of symptoms reported under nine autonomomimetic drugs were related to scores of autonomic balance, but that autonomic reactivity under the drugs was related more closely to autonomic reactivity to a placebo. This study and many other observations convinced us that measures of autonomic balance in a resting state must be supplemented by measures of response patterns to stimuli for which the normative response is established, if ANS data are to prove of more than limited usefulness in the prediction of behavior.

Although many investigators have studied reactivity of discrete ANS functions, and a few have used several variables in their studies,[2] the validity of one, or a few, ANS variables as a measure of total ANS response has never been investigated. A comprehensive and systematic research seemed indicated. Accordingly, our present program on "Studies of Autonomic Response Patterns" was undertaken.

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[2] This work is reviewed in connection with other publications from this project.

This program, which got underway in 1954, has the following specific objectives:

(1) To develop practicable techniques of measurement and statistical analysis of autonomic response patterns in man.

(2) To investigate resting, primary, recovery, and secondary autonomic response patterns in man to a variety of physical and psychological stimuli in order to determine (a) group central tendencies to specific stimuli, (b) the nature of individual response pattern differences, and (c) the possibility of classifying stimuli according to group response patterns.

(3) To investigate the value of autonomic response patterns in standard test situations for the prediction of psychosomatic and other abnormal reactions to subsequent stressors.

(4) To investigate the relationship of autonomic response patterns to personality.

(5) To test the hypothesis that emotional behavior in man is characterized by at least eight fundamentally different autonomic response patterns.

(6) To determine the most significant variables in autonomic response patterns, so that the number of variables in future research may be reduced.

Certain general hypotheses also may be mentioned:

I. Patterns of autonomic response in man demonstrate consistent variation according to the stimuli which elicit them.

II. Differential autonomic response patterns in man provide a basis for an objective classification of stimulus effect.

III. Consistent individual differences in autonomic response patterns to a given stimulus occur in both primary and secondary responses.

IV. Individual differences in autonomic response patterns, supplemented by differences in autonomic balance, furnish a basis for the prediction of men who cannot well withstand physical and psychological stress and men who may develop specific psychosomatic and other psychological disorders.

V. Such predictions will afford a background for preventive therapy which will serve to decrease the frequency of psychological disorders.

The long-term objectives of the program are to test the above-stated hypotheses by simultaneous measurement of as many ANS responses as prove practicable, as elicited by a wide range of physical, physiological, and psychological stimuli, with a follow-up study of subjects with respect to life-stress reactions and disorders.

The remainder of this report describes our methods of measurement.

(A) General Apparatus: Twelve channels of recording include an 8-channel Offner[3] type D3 Electroencephalograph, three type 133 Offner DC amplifiers, and one special channel. The console accommodates a 24 inch Offner Dynograph (polygraph) which employs 11 standard pen-motors with 6 ohm coils and one special 600 ohm pen-motor. Six paper speeds are available: .125, .25, .625, 1.25, 2.5 and 6.25 cm./sec. Our typical recording speed is .125 cm. per sec., or about 3" per minute. A special filter switching panel provides for independent variable time constants when recording through the pre-amplifiers of the D3; and the chopper-type amplifiers employed in this apparatus permit drift-free DC recording when the pre-amplifiers are by-passed. Impedance matching in the latter case is accomplished by means of coupling transformers to which a balancing circuit is added to allow manual re-centering of the pens. Such couplers are comparable to the Offner Input Coupler, type 9138. The 12th amplifier is specially constructed to drive the 600 ohm pen, used in recording stomach motility, and is described elsewhere (11).

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[3] Offner Electronics, Inc., Chicago 25, Illinois.

Two other channels of information are used: (a) A Gilson[4] Automatic Blood Pressure Recorder (4) provides automatic inflation and deflation of a standard area cuff at any of four time intervals (1', 5', 30', 60'), or by manual control. The pulse sound from the brachial artery is detected by a Brush pressure microphone, amplified, and recorded on chart paper which moves only as the cuff deflates. A second pen records the inflation pressure, which is pre-set, and the curve of deflation. The chart is calibrated in mm. Hg., and the points of appearance and marked muffling (1st and 4th blood pressure phases) can be read on the deflation curve as systolic and diastolic blood pressure respectively. (b) A Bolex, 16 mm. motion picture camera loaded with Eastman cine-kodak high speed infrared film, emulsion #2183, is used to record changes in the pupils of the eyes and/or facial expression. Two Sylvania infrared self-contained reflector type heat lamps are placed three feet from the subject and directed at his face. The increase in temperature on the face is negligible[5] since the lamps are operated at 55 rather than 110 volts AC. A type 200 C, 5 amp. General Radio Company variac is used to reduce voltage input to the lamps. The camera may be operated manually by remote cable control or by a motor-driven trigger. For most work the latter is employed with one exposure every three seconds. Calibration is accomplished with a black grease pencil mark of known length drawn directly below the subject's left eye.

All of the above apparatus except the camera and its automatic trigger are contained in one room. In an adjoining semi-soundproofed room is a shielded cage (size 9 x 6 x 6 ft.) which houses the cot for the subject and the pick-up units which are described in the following sections. The cot consists of a foam-rubber mattress on a firm wooden base so that no movements of metal structures occur. The head of the cot is adjustable, with hinges at 21 inches from the top. The typical elevation is 6½ inches. [Initial work employed a chaise-lounge with rope support for the pad, which is shown in published pictures of our laboratory (12, p. 268). It has been supplanted by a structure which is longer, wider, and higher.]

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[4] Gilson Medical Electronics, Madison, Wisconsin.

[5] The temperature at the concentration point of the two lights was found to rise 1°C within ten minutes and to maintain this level for 40 minutes.

A window between the rooms permits observation of the subject, and furnishes reflected light to the subject's room--the only lighting typically employed. An intercommunication system permits constant monitoring of sounds from the subject's room, and communication with the subject when desired. Any or all of the communication may be recorded on a long-playing tape recorder. An air conditioner provides constant room temperature in all seasons.

(B) Recordable Variables: Three of the recordable physiologic variables already have been mentioned: pupillary diameter and systolic and diastolic blood pressure. Others are described in the following paragraphs. All utilize the Offner AC/DC equipment, and are selected according to the experiment.

(1) Electrical Skin Resistance: For recording skin resistance, a constant current of 40 microamperes is impressed through electrodes made of zinc plates 2 cm. in diameter, encased in a plastic cup. Contact with the skin is made with an agar-zinc sulfate electrode paste.[6] A Darrow-type bridge (2) with a range of 500,000 ohms is utilized, and the output is DC amplified. Calibration is determined by bridge regulation.

(2) Respiration: The pick-up for respiration consists of an aluminum plate .035 inches thick, 5½ inches long and 1½ inches wide. The center is bent into an arch within which a Baldwin SR4 type C-14 strain gauge[7] (nominal resistance

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[6] 40 grams of Penick's USP #1 powdered agar-agar, 3 grams zinc sulfate ($ZnSO_4$), in 257 ml. of distilled H_2O. The solution, pre-mixed cold in a 600 ml. pyrex beaker, is placed in a 1" bath of boiling water and cooked with constant stirring for 1 minute and 45 seconds. After cooling it is placed in air-tight jars.

[7] Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.; or the entire pick-up unit is available from Electro-Medical Engineering Co., Burbank, Calif.

2,000 ohms) is cemented. The ends of the aluminum plate are attached to a cloth strap which fastens around S's chest. As respiratory movements bend the plate, the strain gauge is stretched and its electrical resistance changes concomitantly. This variable resistor is one arm of a Wheatstone bridge which is powered by a 22½ volt battery. The output is DC amplified. Amplitude is not calibrated.

(3) Skin Temperature: Temperatures of the face, finger, and axilla (and room temperature) are recorded through a DC amplifier by means of Western Electric type 14B thermistors. Resistances of the thermistors vary from approximately 2,000 ohms at 23°C to approximately 975 ohms at 41°C. Each thermistor functions as one arm of a Wheatstone bridge which is powered by a 1½ volt battery. All temperatures are recorded on one channel by means of a constant speed, motor-driven, selector switch which samples face and axillary temperatures once a finger temperature twice every 10 seconds. Room temperature is selectively recorded by means of a separate, manually operated switch. Calibration is accomplished by substituting known resistances for the thermistors, whose resistances at given temperatures have been predetermined. The sensitivity of each thermistor is controlled by means of a voltage divider from the bridge power supply. Thermistors are attached with adhesive tape which also covers the sensing element, to the right cheek and tip of the right or left hand depending upon experimental requirements. A third thermistor, mounted on a sponge rubber pad and placed in the axilla, is held in position by the pressure of the subject's arm. Room temperature is recorded from a free thermistor.

(4) Heart Rate and Variability: Heart rate appears on several channels. The most dependable measure is the typical EKG attained from AC recording with standard electrodes. Lead II usually is employed. In some experiments a cardiotachometer[8] is used with DC amplification to measure the period of each heart cycle. The pick-up electrodes are the same as those for the EKG except that lead IV is used to obtain maximum QRS potentials. Condensor discharge time reflects individual

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[8] Constructed by Electro-Medical Engineering Co., Burbank, Calif.

heart periods, and determines the deflection of the recording pen. Calibration involves a constant speed motor with a series of contacts designed to establish records equivalent to 30, 90, 120, and 180 heart cycles per minute.

(5) Finger Plethysmograph: A small plastic cup is placed over the index finger so that 4 cc. of the finger are enclosed. The system is made air-tight with caulking compound. Tygon plastic tubing (size 3/8" diameter) connects the cup to a P97-0.05D-350 Statham pressure transducer[9] used as a gauge transducer. Blood volume changes in the finger then activate the unit which is powered by a 10 volt battery. Amplification is either DC, as is typical, or AC. The latter has certain advantages and is being investigated (1). A balancing and calibrating circuit described by Statham is utilized. Calibration is accomplished by switching a resistor in parallel with one arm of the transducer bridge. The resulting pen displacement equals that produced by a digital volume change of .01 cc.

(6) Leg Plethysmograph: A standard blood pressure cuff is placed around the calf of the left leg, and inflated to 20 mm. Hg. Pressure changes from the cuff produced by changes in blood volume of the leg activate a Statham P5-0.2D-1800 differential pressure transducer powered by a 28 volt battery. The output typically receives DC amplification, but AC recording is being investigated.

(7) Stomach Motility: Only a brief description will be given here since the technique for recording this function is discussed elsewhere (9, 11). The subject swallows a 3/16" x 1/2" plastic-coated cast Alnico #5 magnetic rod,[10] the movements of which are remotely detected by a modified Waugh Magnetometer.[11] A magnetic phase detector generates a variable current which is proportional to the lines of

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[9] Statham Laboratories, Inc., Los Angeles, 64, Calif.

[10] Terry Sales Corporation, 2910 South La Cienega Blvd., Culver City, Calif.

[11] Now manufactured by E. M. Irwin, 1238 S. Gerhart Ave., Los Angeles, 22, Calif.

magnetic force cut by the magnet. The signal is increased by means of an AC amplifier and then is filtered to give a DC signal. Recording is either by standard Offner DC equipment or with our special amplifier (11).

(8) Muscle Potentials: Muscle activity of frontalis or of the flexors and extensors of the left forearm is measured in some experiments with silver electrodes, 8 mm. in diameter and 10 cm. apart. Cambridge electrode jelly is used to maximize conductance; and the electrodes are secured to the skin by means of collodion. The Offner D-3 has a built-in calibrator which covers a range of 10 to 1,000 microvolts in seven steps. This is utilized to calibrate muscle potentials and other AC signals.

(9) Salivation: We have made many attempts to record salivation continuously, either by weight or volume displacement. Such measurement requires a wide range of operation with great stability and sensitivity. The most promising technique at present consists of a lever system comprising a steel plate, 8½ inches in length, 3 inches wide, and .08 inches thick, attached solidly to a plastic block on one end and engaging a Statham G1-1-1000 force transducer on the other end. A graduated 100 ml. cylinder is fastened to this plate. One tube from the double-hole stopper closing the cylinder goes to a rubber-tipped saliva ejector which is placed in the subject's mouth, and another goes to a negative pressure pump. As the saliva is collected in the cylinder the added weight bends the plate slightly and activates the transducer which is very sensitive, having a maximum range of 2 oz. and a maximum displacement of .003 inches. Twenty volts is impressed across the transducer bridge and the output receives DC amplification. A 1000 MFD, 25V Cornell-Dubilier dielectric capacitor is placed across the output to filter out disturbances caused by the negative pressure pump and movements of the subject. The calibrating resistor is chosen to give a pen displacement equivalent to a weight of 2 ml. of H_2O introduced into the collecting bottle. Increases in rate of salivary flow are reflected by a steeper slope of the recorded line.

(10) Ballistic Index of Cardiac Output: The pick-up for this measure is an astatic L-12-U crystal phonograph cartridge with a maximal signal output of 4 volt A 4.3 megohm load resistor is placed across the output terminals. The cartridge is encased in sponse rubber without a phonograph needle and is strapped to the subject's leg six inches above the ankle. The signal receives AC amplification and calibration is in microvolts. The record provides a crude measure of cardiac output.

(11) Radial Pulse: Exploratory work has been done employing a Statham P81-5G-350 transducer placed over the radial artery in an effort to obtain a continuous measure of systolic and diastolic blood pressure. Attachment has been made with rubber sponges and straps, or with a plastic band shaped to curve around the wrist and hold the transducer in place. Initial results with this technique appear promising but a number of improvements are necessary. In particular the system is too sensitive to movements by the subject. A more appropriately shaped transducer and a better method of attachment are indicated.

(12) Motility of the Lower Bowel: A bipolar electrode of our own design is inserted into the lower bowel through the anus and is held in place by the internal sphincter. Both AC and DC records of changes in potentials have been obtained from a few subjects. If further work indicates that significant date are obtainable by this method the electrode will be described elsewhere.

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